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How Soil Pipe Castings Are Made

Standardized Methods and Ingenious and Efficient Rigging Are Responsible for the Large Output and Low Percentage of Rejections on These Somewhat Unusual Castings

BY PAT DWYER

THE manufacture of soil pipe is a division of the foundry industry which is conducted in an individual manner and one in which the methods and rigging employed exercise a greater influence on the resultant product than the skill of the workmen. To a certain extent it may be compared with roll making and the manufacture of chilled-iron car wheels. These are highly specialized branches of foundry practice and while it is true that the basic principles are the same there are features peculiar to the manufacture of each of the foregoing which would be totally out of place if applied to the others.

It will be quite apparent that to produce a pipe 5 feet 3 inches in length, 4 inches in diameter and with a metal thickness of 3/16-inch, the molding and melting practice must be above question. When it is realized that these pipes are made entirely in green sand by practically unskilled men as the term is usually understood, that they are made in immense quantities and that a variation of a few ounces in the weight is sufficient to condemn them, it will be seen that every factor entering into their construction must have received the most careful consideration.

To begin, a special grade of sand must be employed. This does not

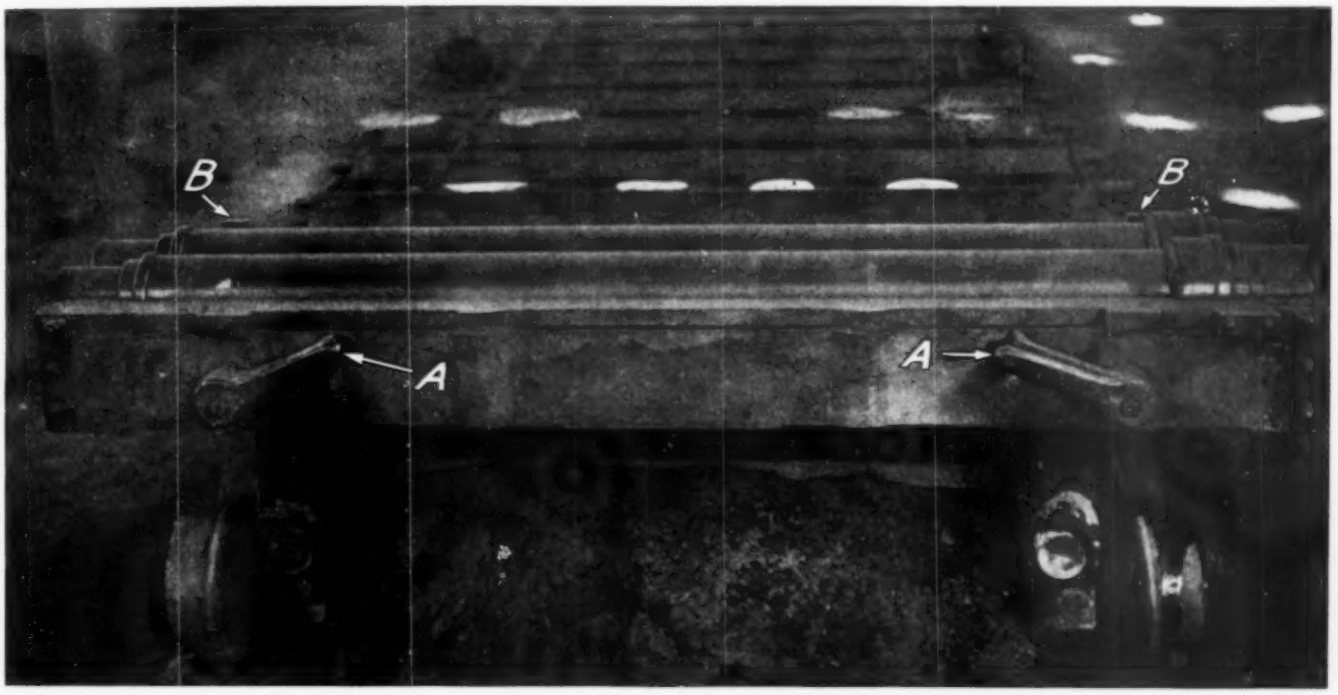


FIG. 1—THE TWO CAST IRON PATTERNS AND STRIPPING PLATE ARE MOUNTED ON A TRUCK AT A CONVENIENT HEIGHT FOR RAMMING BY HAND—AS THE TRUCK MOVES ALONG THE MOLDS ARE PLACED ACROSS THE RAILS AND ARE THEREBY AUTOMATICALLY LEVELLED

mean that there is only one sand bank in the country capable of supplying sand for this purpose. However, it is imperative that a grade of sand must be employed which possesses the apparently contradictory qualities of being able to stick to the arbor and yet be open and porous enough to allow the steam and gas to pass off freely. Where this grade of sand is not available in the natural state, it is customary to select a fairly close sand and add enough sharp sand to bring it to the desired condition. In this connection it might be well to point out that unless the sand just referred to is thoroughly mixed in some form of mechanical mixer, preferably one of the smaller type, the result will not be satisfactory.

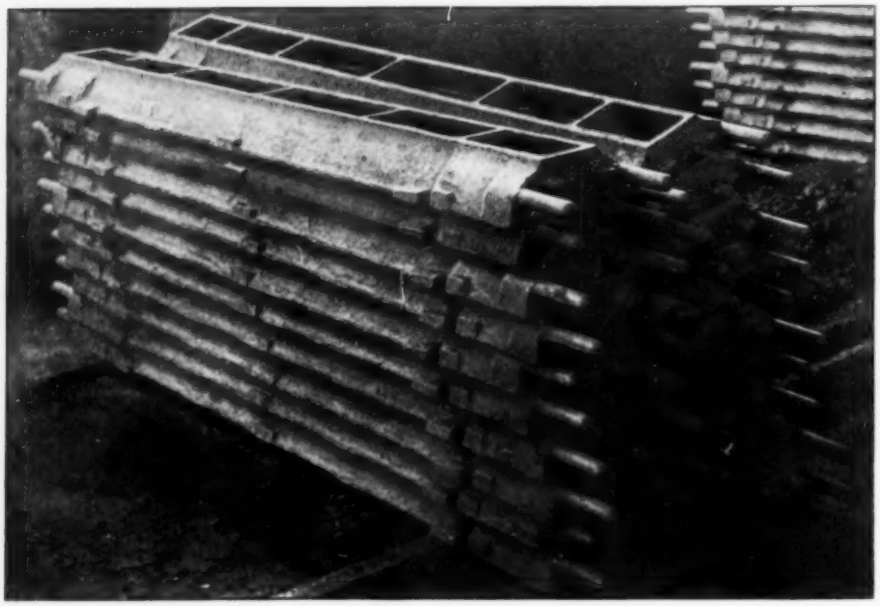


FIG. 2—THE SIDES OF THE RIGID ONE-PIECE FLASKS ARE DESIGNED TO CONSERVE SAND AND LABOR—THEY ALSO OBVIATE THE NECESSITY OF EMPLOYING BOTTOM BOARDS

Hot Iron Essential

Other requisites for the successful production of soil pipe castings are accurately fitting and interchangeable flasks and core arbors, absolutely true patterns and last but not least, hot iron with which to pour them. Other things equal, the efficiency of a plant may be measured by the percentage of defective castings produced over a given period. On this basis the plant of the Somerville Iron Works, Somerville, N. J. with an average record of less than 3 per cent defective castings from all causes may fairly be said to exemplify the best practice in connection with the manufacture of soil pipe including all the special fittings. The company operates another large plant devoted to the same purpose in Chattanooga Tenn., where the same practice is pursued as in the New Jersey plant. There are two minor points of difference between the operation of the two plants. The first is that colored molders are employed in the southern plant and the second is that it has been found necessary in that plant to provide core arbors with a greater number of holes on account of the difference in the sand.

The plant at Somerville, N. J., which at present has an output of about 80 tons a day, has been developed and brought to its present high state of efficiency under the supervision of the manager W. J. Kirby. He designed the layout and has invented and patented all the machines on which the molds are made. During the many years he has been manager of the plant he has had an opportunity to standardize all the equipment and processes and also to build up an organization which functions smoothly and efficiently. Intimate personal relations are maintained between the men and the management, a feature responsible in a great measure for the success of the plant. Whenever any of the employes or members of their family are sick or in trouble cognizance is taken of the fact at the office of the company and suitable steps are taken to render material assistance. Financial help always has been available and has been taken advantage of quite freely by men desiring to own their own homes. The company maintains that this line of action not only is an exemplification of the square deal but also is good business policy with a real tangible, monetary value.

Three Cupolas Employed

The foundry building, of brick and steel construction adequately lighted and ventilated, is divided into three parts by brick walls which served as the confining walls of a former building. When the large new addition was built several years ago, a higher roof was erected over the entire building. Openings connecting the different departments were cut through the dividing walls, but otherwise they were not disturbed. The cast iron columns supporting the roof were cast in the company's foundry.

Three 60-inch cupolas are provided for melting the iron. One is located in the old shop and the other two in the new part. All three are placed well in toward the center of the shop to facilitate the distribution of the iron. The charging platforms extend from the cupolas to the side wall of the building nearest the stock yard. A long elevated platform on the same height as the charging floors extends along the wall on the inside and is provided with tracks so that the materials for the charge coming up on the two elevators, one at each end, can be diverted to any

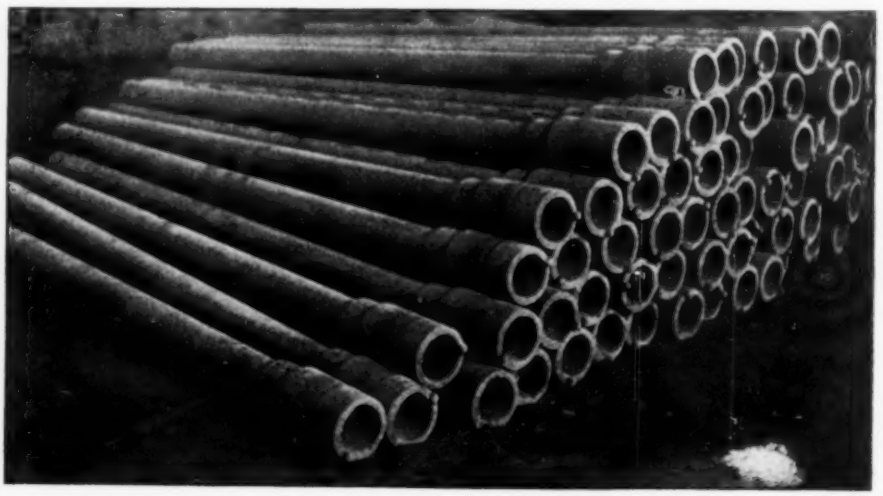


FIG. 3—THE ARBORS ARE MADE OF CAST IRON ABOUT ¾-INCH THICK—THEY ARE PROVIDED WITH A SINGLE ROW OF VENT HOLES AT DIAMETRICALLY OPPOSITE SIDES—THE LITTLE KNOB ON THE END IS A REMINDER TO THE MOLDER TO SET THE CORE IN THE MOLD WITH THAT SIDE UP

one of the several cupolas as is desired.

Narrow gage tracks extend outward from the ground floor entrance of the elevators to different points in the stock yard. The materials forming the charge are loaded on a number of cars in the yard and then pushed by hand to the elevators. The charging floors are provided with double tracks and suitable turntables. The cars are propelled toward the cupola on one track, passing over a platform scale on the way. As each one approaches the charging door in turn, the part of the charge loaded thereon is removed and pitched into the cupola by two men stationed there for that purpose. The car is then pushed a little farther ahead and switched onto a parallel track which leads back to the elevator. It will be observed that the material forming the charge is only handled twice, once when it is loaded on the cars and again when it is lifted off and thrown into the cupola.

Charges Are Uniform

The bed charge of coke in each of the cupolas consists of 3000 pounds. Succeeding charges of iron, 5000 pounds and coke, 600 pounds are kept uniform throughout the duration of the heat. The blast for each furnace is supplied by an individual motor and positive pressure blower capable of delivering about 8000 cubic feet of air a minute. The composition of the charges varies from time to time, depending on market and transportation conditions. However, the analysis is held as nearly as possible to approximately 2.25 per cent silicon. The other elements may vary to a considerable degree without affecting the product to any extent.

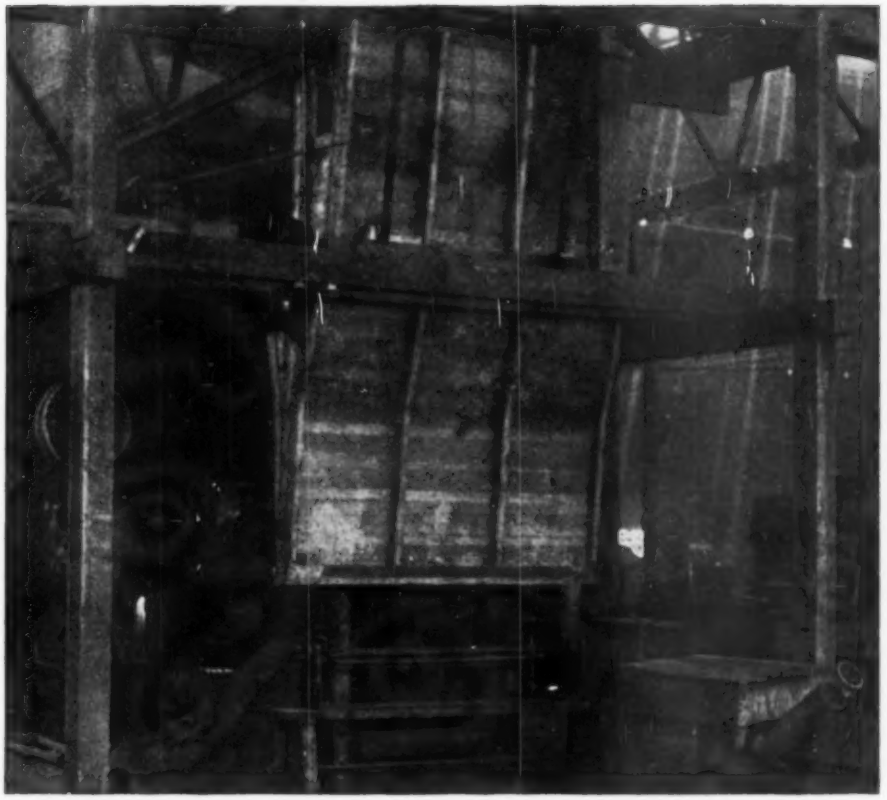


FIG. 5—IN THIS POWER OPERATED CORE MAKING DEVICE THE SAND IS ELEVATED TO THE HOPPER AND SCREENED MECHANICALLY—ALL THAT IS NECESSARY ON THE OPERATOR'S PART IS TO LIFT THE ARBORS ONTO THE GUIDES AND AFTER A FEW REVOLUTIONS REMOVE THEM

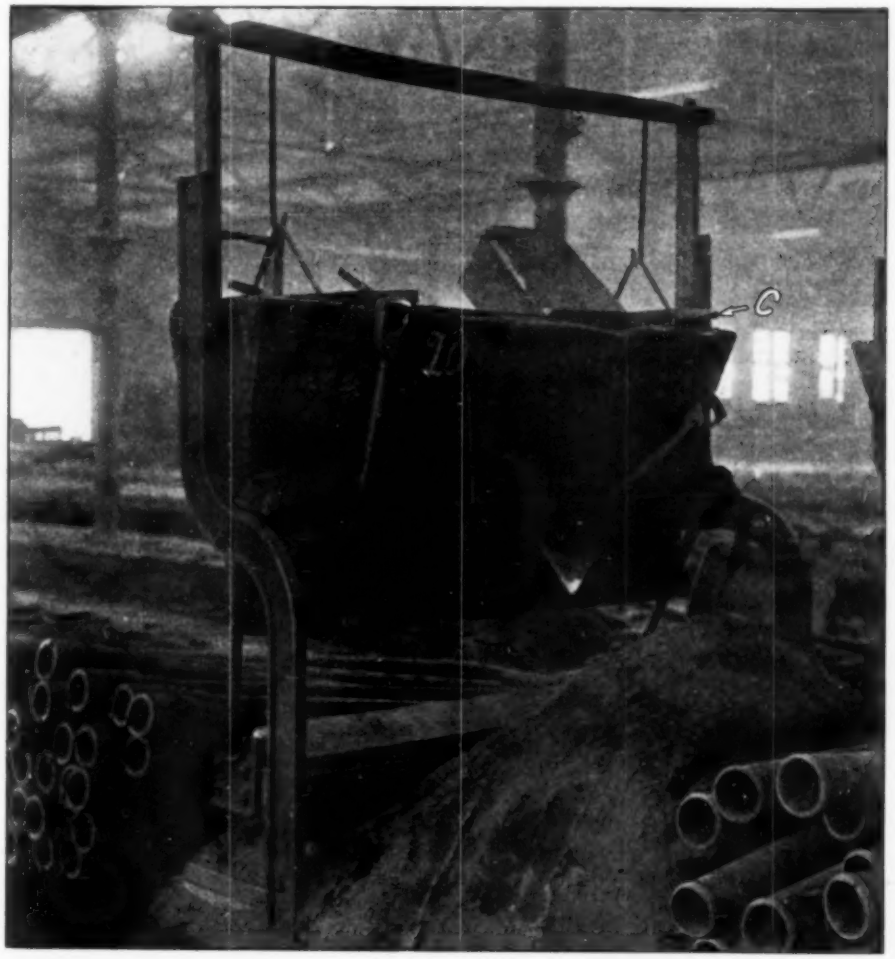


FIG. 4—THE SAND FALLING THROUCH THE HOPPER ADHERES TO THE REVOLVING CORE BARREL—THE SURPLUS SAND IS REMO'ED BY A SUITABLE STRIKE ATTACHED TO THE FRAME

Accurate Flask Equipment Required

One of the machines for making the straight lengths of soil pipe is shown in Fig. 1, and a pile of empty flasks used in connection with the same job is shown in Fig. 2. The outstanding features of this equipment are ruggedness, accuracy and simplicity. The machine is substantially constructed throughout. A cast iron frame mounted on four truck wheels is surmounted by a flat, cast-iron, stripping plate accurately machined and fitted. The patterns are cylindrical hollow castings ¼-inch thick. They are turned and finished all over and are held simply by their own weight in the cradles provided on the under side of the frame. The snug fitting stripping plate prevents them from moving either endways or sideways and if they happen to turn around it does not make any difference, because they are perfectly round. A toggle arrangement inside the frame and controlled by a lever at-

tached to the far side of the frame shown in the illustration serves to manipulate the patterns up and down.

The shape of the patterns and the generous amount of draft allowed at the ends makes it necessary to drop the patterns only about ¼-inch through the stripping plate before lifting the flask. In addition to two guides bolted to one side of the pattern plate, the patterns themselves furnish all the necessary guides for locating the flasks. The ends of the core prints are turned to fit the opening in the ends of the flasks and locate them accurately in the transverse direction, while a shoulder at the large end against which each flask is crowded hard, serves to locate them longitudinal-

FIG. 6—THE MACHINES FOR THE SMALLER SPECIAL SHAPES ARE ARRANGED IN PAIRS WITH A BENCH BETWEEN ON WHICH TO MAKE THE CORES

ly. The clamps, indicated at *A*, Fig. 1, are employed to hold the flask firmly in place while it is being rammed full of sand. The lugs on the flasks are wedge shaped and therefore, the clamps tighten automatically when they are forced on. It will be noted that the flat guides, the tops of which are shown at *B B*, Fig. 1, are attached to the side of the machine nearest the line of finished molds. In this way the danger of striking them with the empty flalsks while swinging the latter into place is eliminated and since it is necessary to lift the rammed flasks high enough to clear the patterns, there is no danger of striking the guides with them.

Copes and drags on the long flasks are alike and are interchangeable. Each piece is cast as a complete unit including the handles, bars and guide lugs. This construction insures a firm, substantial flask with nothing to work loose or get lost. The face of the joint is machined as also are the lugs which come into contact with the guide. The sides of the flasks shown in Fig. 2, have been slanted sharply, a design adopted to save time, labor and sand and to prevent the pressure of the molten iron from breaking through the mold either at the bottom or at the top. This feature also helps to reduce the total weight of the rammed flasks and enables two men to handle them readily.

The molds all are rammed by hand in this foundry and the regular days work for two men is 38 flasks. As each flask contains two pipes, this means 76 complete pipes a day. The total daily output for the shop is about 2000 straight sections and an equal number of specials, elbows, tees, return bends, etc. The manufacture of the straight sections will be considered first and briefly some of the distinctive features peculiar to the special shapes will be noted afterward.

Each floor is a complete unit and the two men who work on it perform every operation necessary for the production of the castings from shoveling over their sand in the morning to shaking out and piling their castings at night. At the time this article was written, the company had secured a sand cutting machine made by the American Foundry Equipment Co., New York; but it was not yet in operation.

The sand is piled in a long windrow between the rails on which the molding machine travels and the flasks are piled in the wide gangways between the floors. Owing to the character of the work, it is possible to keep everything in its allotted place. This results in a clean and tidy shop at all times. The device for making the cores is erected at the end of the floor at which operations start in the morning.

There is no arbitrary rule governing the men in the manner in which they prepare the molds. Some prefer to put down a complete floor of drag molds first, then core them all before starting to make the copes. Others make a few drags and then core them and put the copes on before making any more, and so on. There is no particular merit claimed for any one method and the fact remains that no matter which method is adopted, the cores for the last molds have to be carried quite a distance. The principal reason for making all the drags at one time is to insure against the possibility of forgetting to set the gates. The copes and drags are rammed upon the same pattern plate and where copes and drags are made intermittently, mistakes are liable to occur. However, when all the drags are rammed at one time, the gates can be set before commencing to ram the copes and then no further attention need be paid to them. The molds are poured *four-up* with metal caught directly from the spout. The men from alternate floors help each other pour off.

Sand Must Be Right

The flasks are a close fit for the patterns and it is necessary to ram the sand with a considerable degree of skill and judgement. If it is not rammed hard enough, the castings will strain and come out too heavy and if it is rammed too hard, the molten metal will not lay against the face of the mold. The result will be blown and blistered castings. In either case they are classed as scrap and taken up to the stage to be remelted. The tempering of the sand also requires the closest attention. If it is too dry, the molds will not lift satisfactorily from the pattern plate, and if it is too wet, the metal will not lie against it. The action of molten metal is practically the same whether it comes into contact with a wet mold or a hard mold. The men ram the molds with their shovel handles. After the drags are rammed, they are lifted off, turned over and placed across the rails on which the molding machine travels back and forth. It is necessary that they be poured in a perfectly level position and the rails fulfill this condition admirably.

The copes are rammed in a similar manner to the drags. They are not rolled over; but lifted directly from the pattern plate and set on the drags. A

continuous gate extends almost the full length between the two patterns. It is connected to the molds on each side by a number of light shallow branches about 2 inches apart. Four sprues spaced at equidistant intervals serve to convey the iron from the ladles to the gates.

A set of core arbors for one of the floors is shown in Fig. 3. The little knob on the end of each one is for the guidance of the workman when placing the core in the mold. A single row of ½ x 2-inch vent holes extends along the diametrically opposite sides of the arbor. If the part of the arbor containing the holes happened to come in front of the gates the metal would burst through, and since it is impossible to see the holes after the arbor is covered with sand, the knob on the end of the arbor where it always is in plain view has been adopted. This knob is on the same line as one of the rows of vent holes and consequently it only is necessary to drop the core in the mold with the knob showing at the highest point to be sure that the lines of vent holes are away from the gates. Furthermore, having a row of vent holes along the highest surface of the core facilitates the escape of the gas and steam and prevents blisters and bubbles on the upper surface of the casting.

Making the Cores

Perfectly straight, cylindrical and uniform green sand cores are made on a number of similar devices scattered throughout the shop. One of these, shown in Fig. 4, is located at the back of each floor. It consists of an upright at the top and tapering down to a narrow slit at the bottom. An oscillating riddle operated by hand is hung inside the top of the hopper and serves to screen the sand before it is discharged through the bottom. Two semicircular guides are attached to the lower part of the frame. These are accurately machined and support the core arbors while the latter are being covered with sand.

Instead of machining the large end of the core arbor, loose rings are made and machined to fit the core print and the opening in the end of the flask. Before making the core, one of these rings is slipped onto the end of the arbor and fastened there with a wedge. The arbor then is clay washed and set in the guides attached to the coremaking device. A suitable strike extends from one guide to the other and regulates the thickness of sand allowed to adhere to the arbor. A crank handle terminating in a tapered plug is attached to the arbor by the simple expedient of inserting the plug in the large opening at the end. A little pressure is sufficient to hold the plug in place while the handle is employed to turn the arbor. Two men lift the arbor into the guides, then one throws a couple of shovelfulls of sand into the screen in the hopper. He shakes the screen by the handle *C*, while the second workman turns the arbor. The force of the falling sand is sufficient to make it adhere to the arbor and the strike already referred to gives the core the required shape and dimensions. Ten or twelve rapid revolutions of the arbor results in a finished core. The last revolution always terminates at a point that leaves the guide knob on the end of the arbor uppermost. The crank handle then is removed and each man inserts a short bar in his end of the arbor, and having lifted it out of the guides, carries it to one of the open molds and lowers it into place. A mechanically operated core making machine, shown in Fig. 5, recently has been erected by which it is proposed to make the cores for a group of molders and allow them to devote all their time to making the molds. The molds are poured simultaneously in rotation as was noted.

The space under the cupola charging platform previously mentioned, is utilized for housing the tumbling barrels and chipping benches. Due to the fact that all these castings are made entirely in green sand with accurate rigging and close fitting flasks, the chipping and grinding are reduced to a minimum. In fact, many of the castings pass directly from the tumbling barrels to the tank where they are dipped in tar.

An endless chain conveyor provided with detachable hooks is employed to carry the castings from the cleaning room to the shipping platform. On their way they pass through an oven heated by an open coke fire where they are heated to approximately 300 degrees Fahr. A tar tank which is kept heated by steam coils is placed on the far side of the oven and by an ingenious dip in the conveyor line, the pipes are lowered into the liquid tar, lifted out again and allowed to drip for a distance of about 50 feet. They then are removed from the hooks and either piled directly into railroad cars for shipment or stacked on a platform provided for that purpose.

The special shapes, elbows, bends, tees, etc., all are made on stripping plate machines and rammed by hand. Some of the machines are single, but most of them are double like the one shown in the illustration, Fig. 6. They are mounted on wheels and may be moved along following the diminishing sand heap as the day's work progresses. The foundry is not equipped with overhead conveying machinery of any description and it follows, therefore, that the wheels on the molding machines are a decided convenience when it becomes necessary to move them from one part of the shop to another.

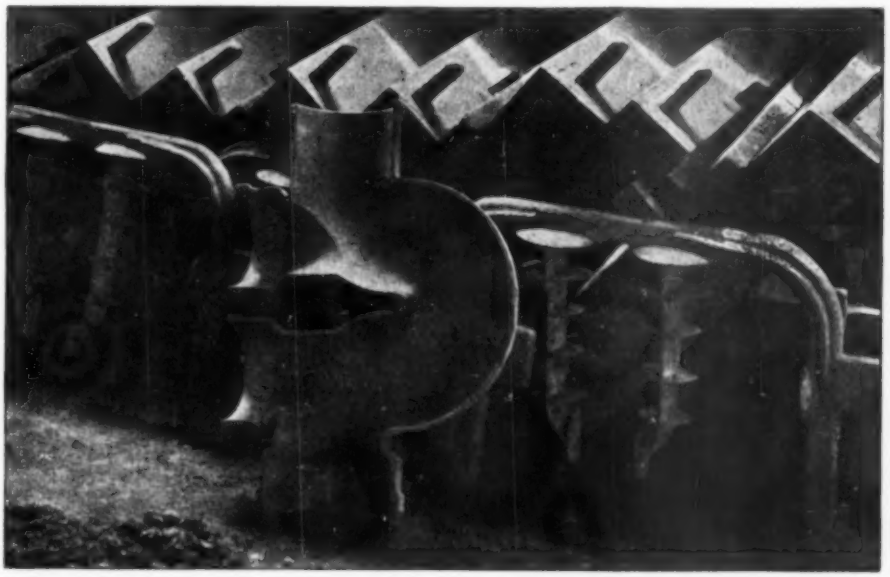


FIG. 7—PATTERN, FLASKS AND ARBORS FOR A DOUBLE RETURN BEND—NOTE THE OPEN YET RIGID CONSTRUCTION OF THE ARBOR AND THE DEVICES ADOPTED TO PREVENT THE CORE FROM SHIFTING UNDER THE PRESSURE OF THE MOLTEN IRON

Operating the Machines

The movement of the patterns through the stripping plate is controlled by a quarter section of a hand wheel shown at *D*, Fig. 6. A collar on the hand wheel shaft provided with a finger which alternately engages two stops on the side of the machine frame determines the high and low position of the patterns. On the machine in the illustration, Fig. 6, it is possible to work three men in a

(*Concluded on Page* 50)

Automobiles Stressed Too Strongly

Importance of the Automotive Industry in Its Relation to the Manufacturers of Metal Products Has Been Over-Emphasized—Consumption of Castings Estimated

BY JOHN W. HILL

CURTAILMENT in the production of automobiles and announcements of sensational price reductions based on "anticipations of cheaper raw material costs," have centered attention upon these three questions:

What is the relative importance of the automotive industry as a consumer of the iron and steel product?

What will be the probable ultimate effect of curtailment of automobile production upon the iron and steel market?

To what extent can automobile price reductions be absorbed by lowering the cost of iron and steel used in their manufacture?

The whole problem has been confused by the meteor-like growth of the automobile industry, together with its spectacular bidding-up of quotations of certain products, among which are castings, during the past year. This has lead many observers into the natural error of overestimating the importance of motor car manufacture as a factor in the iron and steel market and of importance to the foundry industry.

Careful investigaton and analysis of the facts show that the automobile demand has been a dominant influence only in certain restricted spots of the iron and steel industry. Consequently the direct effect of a smaller output of cars upon iron and steel prices would be confined to those special areas.

When compared with the total output of all steel mills of the United States the consumption of the automobile industry dwindles into a percentage of surprising insignificance. During 1919 when floodtide of motor car production attained its greatest height, with a total of 1,974,016 passenger cars and trucks but 3.5 per cent of the year's aggregate output of rolled finished steel was consumed in this manufacture. Of the total ingot production in 1919 the percentage of automobile consumption was but 2.6 per cent. It is doubtful if it reached this figure in 1920 considering the sharp retrenchment of the automobile plants during the second half.

From these facts it would seem clear that the consumptive capacity of the automotive plants, scarcely is sufficient to exert far-reaching influence upon the iron and steel industry as a whole. This is because the general consumption of iron and steel is so diversified that the slowing down of any single line of industrial effort, excepting possibly the railroads, is not reflected to any important degree in mill and furnace operations. At the same time, recessions of business usually are general and not confined to individual lines of industry. For that reason the iron and steel industry interlaced as it is with various branches of production, is quickly affected by such conditions.

The largest buyers of iron and steel are the railroads Estimates have placed their annual purchases in normal years as high as 33 per cent of the aggregate output of finished steel. While the absorptive power of the automobile plants lacks importance when compared with the total iron and steel tonnage demanded by the railroads and by the country at large, it is true that at some points continuous operations and healthy earnings are dependent wholly, or in a considerable measure, upon the prosperity of the automotive industry.

PIG IRON CONSUMED

Year	Production	Automobile Consumption	Per centage
1919.....	5,825,000	621,745	10.6
1918.....	6,080,069	363,395	5.9
1917.....	6,200,521	588,719	9.4
1916.....	6,394,682	498,839	7.7
1915.....	5,631,632	281,174	5.0
1914.....	5,064,860	179,249	3.5
1913.....	6,074,193	147,775	2.4
1912.....	5,825,000	119,070	2.0
1911.....	5,012,000	66,150	1.3
1910.....	6,043,000	58,985	0.96
1909.....	5,900,000	40,125	0.66
1908.....	3,961,000	20,475	0.51
1907.....	5,990,000	13,860	0.23
1906.....	4,993,000	10,710	0.21
1905.....	5,325,000	7,875	0.14
1904.....	4,025,000	6,930	0.17

How Much Is Used?

In 1918 the war industries board requested from the National Automobile Chamber of Commerce information regarding the quantities of metals used in the making of automobiles. According to the data supplied the governmental body by the statisticians of the automobile organization, the average motor car requires in the way of iron and steel, the following:

200 pounds of steel in bars and billets.
113 pounds of steel springs.
500 pounds of steel sheets.
100 pounds of alloy steel.
630 pounds of malleable and foundry pig iron.

The total of iron and steel products consumed in the production of the average automobile therefore it is shown is 1543 pounds. Of steel alone the amount is 913 pounds and of pig iron about 630 pounds.

In 1919 iron and steel production was at low ebb, due to the steel and coal strikes. The output of automobiles then was the highest ever achieved in one year. Based on the data supplied by the automobile chamber of commerce it is shown that in 1919 there was consumed approximately in the manufacture of motor cars:

27.1 per cent of the total output of black sheets, 13 gage and thinner.
13.4 per cent of the total production of all black sheets.
6.8 per cent of the alloy steel output.
10.6 per cent of the total foundry and malleable pig iron production.
3.5 per cent of the total rolled finished steel production.
2.6 per cent of the total ingot production.

The growth in the consumption of foundry and malleable iron in automobile castings has been a development of major importance in the foundry field. This has resulted in a tremendous spurt of foundry expansions which is estimated at between 25 and 33 per cent in the last 18 months. During the last few years the foundry industry of the country has fluctuated within comparatively narrow limits. The peak of malleable and foundry pig iron output in the pre-war days was reached in 1913 with a total of 6,074,193 tons. This exceeded the 1919 output of 5,816,462 tons. In 1913 the motor car trade, it is estimated used only 147,775 tons of pig iron or 3.5 per cent of the whole production. This had grown to 621,745 tons or approximately 10.6 per cent of entire output in 1919.

Although alloy steel is in much demand in the manufacture of automobiles, the total consumption is not large. Only 100 pounds, it is figured, goes into the average car. In 1919 automobile plants, it is believed, used about 98,700 tons of alloy steel. This was 6.8 per cent of the total production.

In 1909 but 6386 tons or 0.4 per cent of the total output was consumed.

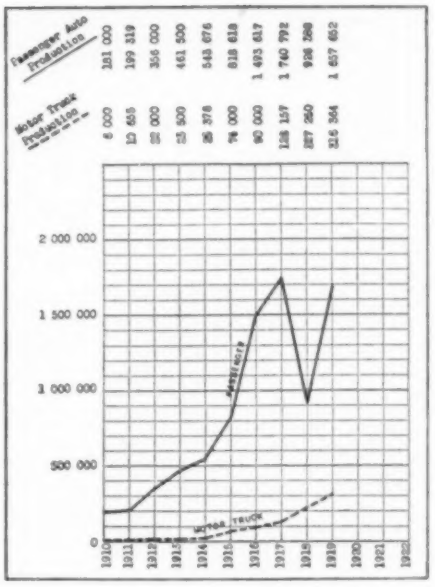
In the nonferrous metals it is estimated that 130,000 tons of lead for storage batteries and for other parts was used by automobile manufacturers and by auto owners in making battery replacements in 1919. This lead in batteries, solder and other alloys, was 27 per cent of the total lead production of 485,000 tons in that year. Active lead buying on account of the automobile activity last year is indicated by the rise of prices to 9.25 cents a pound in April over the low point of around 5.50 cents following the armistice. Since the slump in the automobile industry, lead prices have been falling.

The automobile is a small factor in the copper industry. The average use of the red metal in a single car is 36 pounds. In 1919 automobiles consumed only about 4 per cent of the total copper refined. Most of the copper consumed is in the form of brass; some of it is cast. The greater portion of it is rolled or drawn as sheets for radiators, lights and tubing. It is estimated that approximately 75,000,000 pounds of brass or around 7 per cent of output appeared in finished automobiles made in 1919.

The use of zinc in automobiles is said to average about seven pounds a car. This metal does not enter into construction to any appreciable extent as zinc, but is included in the brass. At the rate given, about 1.5 per cent of the refined output of this metal last year entered into cars. Aluminum, above all other metals, is distinctly an automobile material. Exact figures on this metal are not obtainable, as neither the government nor the sole producer of new metal in this country, gives the information. The automobile Chamber of Commerce has not estimated the amount of this metal used in each car, as with other metals. However, from certain reports and trade conditions it is estimated that the annual output of aluminum is around 120,000,000 pounds and about one-half of this amount is used in automobile castings and sheets. In addition, a fair tonnage of this metal is used in deoxidizing steel going into cars.

The tin used is figured to be 7.5 pounds on the average car, this metal being used to plate radiator parts, and is used in alloys such as solder, babbitt and bronze. At the rate mentioned about 13 per cent of the tin imported as ore and as pig metal into the United States in 1919 entered into the building of automobiles.

About 10.5 pounds of manganese is represented in the average automobile, most of it probably for deoxidizing steel. At this rate about 4 per cent of the total manganese supply contained in manganese alloys produced and imported into the United States last year went into the making of motor cars. This figure would appear to be a liberal estimate and the true amount may be less, as the figures are indefinite, it is not clear whether the 10.5 pounds refers to the metallic manganese content of alloys or to manganese alloys in bulk.



MOTOR CAR PRODUCTION SINCE 1910

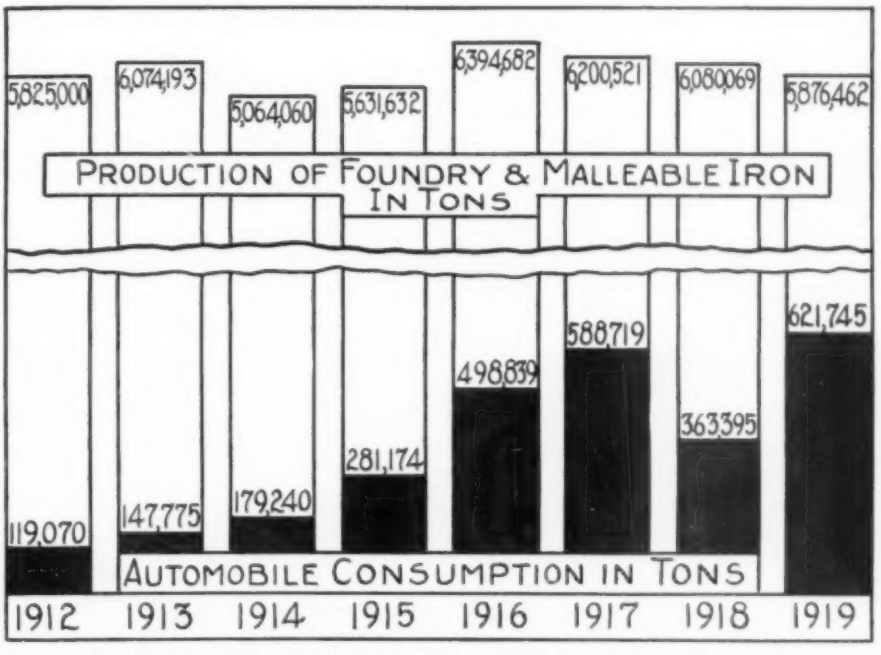
In considering the effect of the automobile industry upon the iron and steel markets no estimate can be made of the vast amount of steel which has gone into new machinery and expansions of motor car and accessory plants. This phase of the situation was of tremendous importance during 1919 and early in 1920. The tire industry alone has grown by leaps and bounds, and enormous quantities of steel for building and for new machinery has been absorbed. A great number of accessory concerns, big and little, also have sprung up. It has been said that the accessory and tire business equal the automobile industry, itself, in point of size, capital involved and labor employed.

In 1919 the number of motor vehicles produced in the United States was 1,974,016. Of these 1,657,652 were passenger cars and 316,364 were trucks. The record in 1919 represented an increase in passenger car production of 78.94 per cent over that of 1918. But 1918 was a war year and automobile manufacturers were forced to curtail output to release labor and materials for war work. As a result the total output slumped 46.78 per cent from the 1,740,792 passenger cars made in 1917. During the 7-year period ending with 1917 the average annual increase in motor car production was over 37 per cent.

The aggregate wholesale value of cars and trucks produced in 1919 was $1,885,112,564. If to this figure is

Growth of Automobile Industry Since 1899

	1899	1904	1909	1914	1919
Capital invested	$5,769,000	$23,084,000	$173,837,000	$407,730,000	$1,802,302,862
Motor vehicle products	3,700	21,975	127,731	569,045	1 974 016
Value of products	4,748,000	30,034,000	259,202,000	632,831,000	2,506,834,594
No. engaged	—	13,333	85,359	145,951	651,450
Wages and salaries	1,616,000	8,416,000	58,173,000	139,453,000	813,731,856



TOTAL AND AUTOMOTIVE CONSUMPTION OF FOUNDRY AND MALLEABLE IRON

added the value of extra parts accessory and tire replacements for the year, the grand total would reach $3,166,834,594. The total number of passenger cars in the United States in 1919 was 6,808,848; the number of motor trucks 750,000, making a total of 7,558,848 an increase of 23 per cent over 1918. At the present time there is one car to every 14 persons in the United States.

What of the future of the automobile? When the demand for cars first began to diminish some months ago an impression gained ground among manufacturers that they were being made the victims of a gigantic conspiracy. Subsequent events have proved this a mere illusion. Like most lines of manufacture the motor industry is undergoing readjustment. Because of its rapid expansion and methods of financing, the motor trade was among the first to feel the effects of general deflation and its readjustment undoubtedly is more severe than in most lines.

The automobile has won a fixed place for itself in modern life however and there is no danger of a breakdown in the industry as a whole. A picture of the automobile industry was painted at a recent meeting of the Motor and Accessories Association by an official of a steel company which supplies steel for parts. He said:

"The automotive industry has overreached itself. It forced sales through easy credits. Then it proceeded to expand in the apparent belief that this extravagant abnormal demand was a permanent thing. Its resources were tied up in brick and mortar and in excessive inventories. When inflation halted, the automobile manufacturers found there was an over-production of many makes of cars. Readjustment will clear away the deadwood for the business. Receiverships and consolidations will appear. But when the readjustment is completed and activity is resumed, I believe the industry will be on a healthy basis. Competition will be strong and for that reason good cars at reasonable prices must be made."

The 1919 production reached almost 2,000,000 passenger cars and trucks. At the beginning of the present year manufacturers optimistically fixed a goal of nearly 2,500,000 cars. During the first six months it is estimated that 1,000,000 cars were made although operations were hampered by the railroad strike and the difficulty of obtaining raw materials. At the present time, under conditions making for a shrinking demand, production is severely curtailed. Few plants are still running at capacity and the majority are estimated to be operating from nearly zero to around 50 per cent of capacity.

The probable normal demand for cars after the readjustment period is completed, is occupying the serious study of manufacturers. In 1913 a total of 461,500 passenger cars were made and sold. With probably 9,000,000 cars in the country now it is evident that the replacement sales alone will be large. Some place this is as high as 1,000,000 cars annually. A number of experts in the trade believe that the normal demand will settle down to from 1,200,000 to 1,500,000 cars annually. This would mean an annual consumption of about 925,000 to 1,150,000 tons of iron and steel.

Some students of business conditions are predicting a period of hard times for the automobile industry. The hothouse conditions recently existing have incubated a total of more than 130 plants constituting a productive capacity which seems above all possible consumption in the opinion of many. Recent price reductions have not greatly quickened sales, generally, reports indicate. In foreign countries automobiles are comparatively few and the European demand for American cars has been large. But decreased buying and industrial depression abroad together with demoralized exchanges are combining to curtail this traffic also.

How Soil Pipe Castings Are Made

(*Concluded from page 47*)

gang. One man works on each stripping plate making the molds while a third man works on the corebox in the center making the cores.

On account of the peculiar shape of all soil pipe fittings, other than the straight lengths, it is impossible to sweep the cores on a core barrel. Special cast-iron coreboxes are provided. These are thin shells conforming to the shape of the desired pipe. They are made in halves and jointed horizontally. The smaller shapes are hinged but the larger coreboxes which also serve as patterns, are provided with dowel pins. Of course the shape of the core is a factor in determining whether the core box be hinged or not. An example of one of the larger size combined pattern and corebox is shown in Fig. 7.

Cores Made in Green Sand

As stated previously, all the cores are made in green sand and therefore chaplets cannot be employed to support the cores on the bottom or to prevent them from floating under the pressure of the molten iron. The core arbors are so designed that they resist this pressure. In some cases the sand above the core prints in the cope is sufficient to hold the core in its place; in others part of the arbor is made to project through an opening in the side of the drag at the joint of the mold. After the cope is set on, a thin edge is slipped between the iron side of the cope and the wing on the arbor.

The main difference between making the cores in the hinged coreboxes and in single half boxes, is that in the first case the entire core is made as a unit, lifted out of the box and set into the waiting mold. In the other, the mold and core are made simultaneously as the corebox is also the pattern. With the hinged corebox, the claywashed arbor is set in what is destined to be the drag half of the core. Sand is thrown in and packed firmly with the fingers. The upper half of the corebox also is packed full of sand but no arbor is employed. After both halves are full, they are scraped off flush with the joint. Then they are brought to a vertical position, both halves slowly closing as they approach each other. Upon touching, the complete box is lowered back on the bench with the half containing the arbor underneath. The top half of the corebox is then rolled back and the core is lifted out.

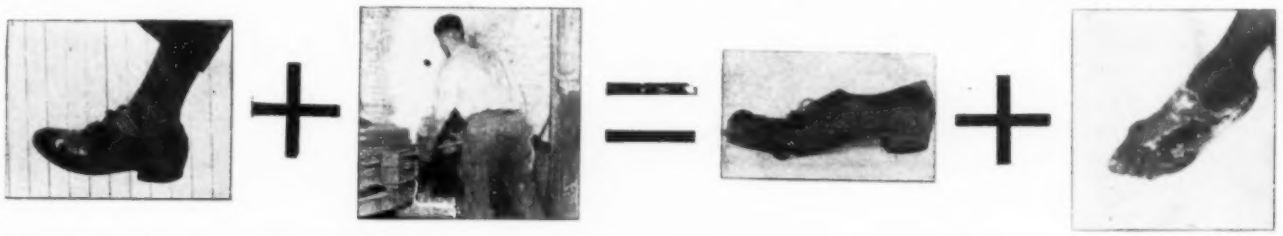
In making a mold and core from one of the larger pipes the practice is slightly different. If the pattern shown in Fig. 7 is taken for an example, the first step is to place one half of the pattern on a rollover board. It will not do to place either half of the board indiscriminately. The core arbor will fit only one half of the pattern and therefore that is the half which must go in the drag. After the drag is rammed and rolled over, a parting is made including a hollow scooped out at each opening in the pattern to serve as core prints. Parting sand is then thrown on followed by a little sand through a riddle after which the arbor is set in and sand rammed up to the parting line on the mold. The top half of the pattern then is placed in position on the lower half and then sand is introduced through the openings and packed firmly, but not hard. The cope is set on next, rammed and lifted off. Then the top half of the pattern is removed after which the core is lifted out and set down while the lower half of the pattern is being withdrawn and the mold finished. The core is then replaced, the cope set on and after the mold is clamped and the arbor wedged it is ready for pouring.

The company makes all its own patterns and rigging, one and sometimes more floors in the foundry being devoted to that purpose. It also maintains a well equipped machine shop for finishing patterns and machinery and for general repair work.

Safe Shoes Reduce Hot-Metal Burns

One Sixth of the Total Foundry Accidents Are Ascribed to Defective and Unsafe Foot-Wear — Foot Injuries Are Reduced by Proper Shoes

Seek New Solution for the Foot-Burn Problem



DOES it pay to furnish the men in the foundry with shoes which are specially made to protect the feet? In an effort to learn the answer to this question, it was propounded to about 1500 operating foundries. Of those who answered, about 55 per cent were buying shoes for their men. Others were considering doing so. Some were encouraging local shoe dealers to carry a stock of specially made molder's shoes. Still others made no effort to supply their men with special shoes.

The answers to this question, however, did not tell the whole story. It is significant that only those employers who were buying shoes for their men were satisfied with the situation. Many firms carrying stocks of shoes of an approved pattern, were enthusiastic over the results. Those not carrying them, on the whole, were far from satisfied and many are considering carrying a stock of special molder's shoes.

It is difficult to ascertain just what the saving has been as a result of requiring the men in the foundry to wear these shoes. Many plants have not pursued this policy long enough to state the positive results, and in nearly all cases, accurate records have not been kept of previous accidents and the time lost due to accidents for any long period. For this reason, the estimated reduction in accidents varied all the way from 3 per cent to 90 per cent. There was one employer who placed the estimate as high as 100 per cent reduction in accidents due to the new shoes. In other words, he had found from experience, that men wearing shoes in perfect condition, never had any accidents to the feet which would cause loss of time.

One plant which has been handling shoes for its men since August 1915, during that time has sold them 13,500 pairs and is now selling 800 pairs of shoes per month, makes the following report: The lost time accidents in relation to the working force for the year 1915 was 1.027 per cent. For the year 1919, this reduced its lost time accidents 66.6 per cent since 1917. While neither of these plants credit the approved shoes with the entire reduction of accidents, they do credit them with a large share in the showing made.

Every plant that has given the proper type of shoes a fair trial, appears to be satisfied that it is a good business proposition to have the men wear them. A number have gone so far as to make the wearing of such shoes compulsory. Others have accomplished the same end by prevailing upon their men to wear them, by selling the idea of safety through care in the selection of their footwear. A study of the results indicates that in order to get the men to wear them willingly, it is necessary to sell them the idea first. After the majority of the men have become convinced that it is to their own interest to wear these shoes, it is not so hard to make the wearing of them compulsory during working hours.

Practically everyone who replied, agreed that a congress type of shoe made of heavy heat resisting leather and with extra strong toe boxes, is the proper style for foundry wear. One man cited the case of a workman who was unfortunate enough to have some molten steel burn through his trousers' legs and run down into the shoe. The leg was not burned, but because he was wearing lace shoes, he suffered a rather severe burn before the shoe could be removed. A congress type shoe would have prevented this accident and saved the lost time.

The value of strong box toes in the shoes is indicated by the following accident which, though not in the foundry, does show the value of safety shoes in all departments:

"A sawman in the cold drawing de-

THAT employers have been giving the problem of foot burns deep consideration is evident from the replies received to a questionnaire sent to about 1500 shops. A portion of a typical reply from a large Canadian interest follows:

** * * A few years ago we purchased shoes for our molders and others handling the molten metal. We purchased congress shoes of good quality made specially for the purpose. A lace shoe to writer's mind is no good, as it takes too long to get off if iron gets on the inside.*

*This supplying of shoes has lasted for possibly two years, and while we have no record as to what good was accomplished by their use, we have no doubt there were results that were beneficial both to the men and firm, and lessened the loss to both. You no doubt are aware that it has been hard to dictate to your employes during the last few years, as no one could afford to run chances of losing men. * * * We have no doubt that if we were to buy the shoes and give them to the men, we could have them all wearing them, but if we are paying them what is right in wages, it is up to them to buy their own shoes.*

It is astonishing when you look at the shoes some of the men handling molten metal wear, and it is a wonder there are not more accidents through being burnt with the metal than there are. Men handling metal every day seem to grow careless and do not realize the danger which is readily seen.

We believe every man should wear these shoes, and not only these shoes but gaiters that come down on the top of the shoe and right up to the knee.

partment was removing a bundle of steel bars from a buggy when a second bundle rolled from the buggy and landed on the toes of his right foot. The bundle weighed about 300 pounds. The shoe was not ruined, other than breaking the box toe. He lost four days from work on account of the contusion, but there is not a doubt that his foot would have been seriously injured had he not worn the heavy box-toe shoes, and the lost time from work would have covered a greater period."

H. P. Brown, timekeeper at the Rock Island Plow Co., Rock Island, Ill., says: "We find in our foundry that all burns from hot iron slopping over from ladle or bull and striking men on their feet when covered with congress shoes, will roll off, as it cannot reach the foot. It would had the molder worn a lace shoe which would catch the iron in the laces and run in to the foot. Should he get hot iron into the top of his shoe, he can in an instant, remove the shoe and prevent a deep severe burn. Had he the lace shoe on, it would be impossible in his great haste, to remove the same and the entire foot would be burned, and especially between the toes and ball of foot, the low spot of the shoe. We instruct all molders in every detail, and have eliminated nearly all foot burns."

Like other types of shoes, foundry shoes will wear out. The shoe which appeared whole and sound yesterday, may be dangerously ripped, cracked or otherwise damaged today. As is frequently the case, the workman may not be aware that his shoes have become defective. To prevent danger from this source, some foremen make it a practice to inspect the shoes of all workmen every day while they are waiting at the cupola for their first ladle of metal; several extra pairs of shoes are often kept on hand to replace temporarily defective shoes which may be condemned. In other plants, a foundry clerk, when "taking up the heat" inspects the shoes of all workmen; and in others this inspection; which takes only a few minutes for each pair of shoes, is made at the beginning of the day. Thus the wearing of defective shoes is minimized, and workmen are more thoroughly impressed with the importance of protection to their feet.

Even foundry shoes will not always provide sufficient protection. Splashes of metal are apt to strike the legs above the shoe tops, burn through the trousers and injure the legs. Sometimes also it is the carelessness of the workman which annuls the safety value of foundry shoes when he wears ragged trousers or those that have holes burned through them at the bottom, or when he forgets to turn down the bottoms of his trousers when working about molten metal after having turned them up earlier in the day. This carelessness comes much more strongly into play when the elastic gore has become weak and the shoe fails to fit the foot snugly, thus leaving an opening at the top not protected by the overlapping trousers, which would otherwise act as a hood over the shoe tops. While an increased height of the shoe would minimize this liability to injury, it would make it more inconvenient and expensive to obtain these special shoes. Some foremen partially overcome this hazard by insisting that workmen's trousers, as well as their shoes, should be kept in good condition. Workmen sometimes close the gap caused by weak gores by snapping a rubber band around the shoe top, but it is obvious that even such precaution is only a makeshift.

THE SUBSTITUTION OF THIS FACTOR FOR THE FIRST IN THE EQUATION NOTED SOLVES THE PROBLEM

The use of leggings would more effectively prevent the entrance of molten metal at the shoe tops, and at the same time would protect the legs of foundry employes. A combination of foundry shoes with properly made foundry leggings would seem therefore to afford the most adequate protection to the feet and legs.

But whether worn in combination with, or without foundry leggings, congress type foundry shoes are best for foundry service.

Those firms which do not supply shoes to their men, do not deny the value of the shoes. Their delay in handling shoes for the men is due more to the lack of success in arousing a desire among the men for the shoes, than to anything else. For this reason, it may be worth while to see how the firms who do handle shoes, get their men to buy them.

Some plants post bulletins of accidents and show how certain type shoes prevented the injuries from being more serious. In each of these bulletins, the men are urged to apply at the store room for safety shoes. Some employers find it practical to compel all their men to wear safety shoes. In other foundries, such action would immediately lead to difficulties. Some foremen and superintendents are able to interest the men in safety shoes by showing them that they will save money by buying and wearing them. The firm buys the shoes directly from the factory and the sale prices save the men a worth while sum in the cost of shoe wear. One foundryman reported that seeing a workman burned was enough to persuade the other men to wear approved shoes without further urging.

In practically all these cases, it is necessary to sell the men the idea of safety shoes in order to have them wear them willingly. To do this, posters, pay-envelope slips, employe house-organs, bulletins, and all other methods of shop publicity are used. The more effectively the advantages of the shoes are brought before the men, the more willingly they wear them and the greater is the reduction in the number of accidents.

Many firms find it necessary to pay attention to the style and the quality of the shoes, in order to sell the idea of safety shoes to the men. Molders are becoming more and more insistent upon having as much fit and comfort in their work shoes as in the shoes they wear outside the plant. They want shoes with flexible soles, soft uppers and made in such a way that they are easy on the feet. The experience of plant physicians in observing the effect on the men of different kinds of safety shoes, indicates that it is profitable to handle the right grade of carefully made shoes. Uncomfortable shoes have been found to increase the fatigue of the men to a considerable extent, which in turn, not only reduces production, but tends toward an increase in accidents. For this reason, unless proper attention is paid to the selection of the shoe, the purpose for which it is to be used, may actually be defeated.

In some cases a stock of shoes is carried, while in a few cases orders are solicited and the shoes ordered as needed from the factory. In either case, it is necessary to place the shoes in charge of some person and have him responsible for them. Some larger plants have the shoes handled by the employment manager. In others, the sale is handled by the receiving department, by the office, by the treasurer, the general timekeeper, the foreman of the foundry, the bookkeeper, the gate man, the purchasing agent, the first aid department, the tool-room man, or by the stock keeper. Who is the best person to take charge of the

shoes depends entirely upon the size of the establishment and the local conditions.

Some foundries sell the shoes to the same price that the factory charges for them. All freight, cartage, storage, etc., are absorbed by the employer. When this is done and it is realized that shoe dealers in order to make a profit, must receive a gross profit on their sales of from 30 to 45 per cent, it is easy to see how great a bargain the men are getting in shoes, and that the price of the shoes alone will sell them to the men as soon as they come to realize how much money they are saving by buying these particular shoes.

Some firms add ten cents to each pair of shoes, some add the freight or express charges to the price charged by the manufacturers, some add about 12 per cent to the cost price of the shoes in order to cover the cost of handling them. In all cases, they sell them at a price, which results in a material saving to the men, while at the same time, it does not add any great amount, if anything, to the cost of production, for in practically every case, the reduction of lost time accidents, and resulting labor turnover, far more than pays for the cost of handling the shoes. It is a proposition that is to the decided advantage of both parties, and as soon as the men are convinced that this is the case and that they are not being made the victims of autocracy or paternalism or subjects of charity it usually is a simple matter to make the wearing of these shoes universal in the plant without making rules compelling men to wear them.

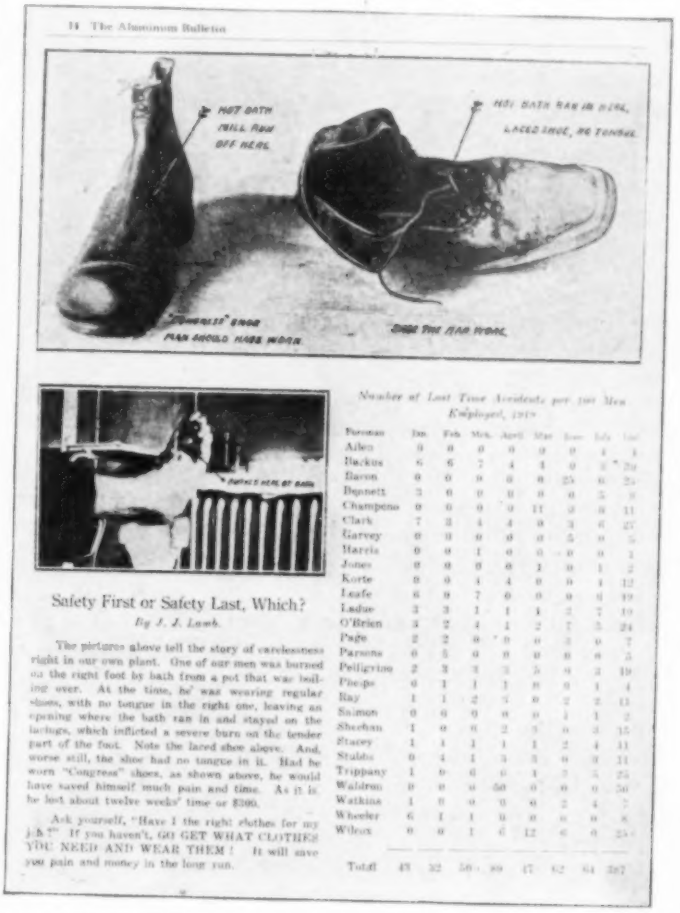
As a matter of fact, many have been so successful in their efforts to introduce safety shoes in the foundry, that the men in the other departments have demanded a similar shoe for their own work. However, in these other departments, lace shoes usually are used, since there is not the need of having a shoe that can be quickly removed. That properly made shoes do prevent a great many accidents in all departments, is indicated by the example already given.

Of those firms communicated with who carry shoes in stock, 53 per cent buy the best shoes that they can get, 40 per cent buy a medium grade shoe, but insist upon high quality, and only 7 per cent handle low quality shoes. These statistics would indicate that those firms which have had the most experience, have found that the best is the cheapest, that quality must be considered as well as price. Twenty-five per cent of the plants handling shoes display samples where the men can study the shoes and the price. They also feature the protective qualities of the shoes and have no difficulty in getting the men to buy them and wear them.

The foundries that compel their men to wear approved types of shoes, appear to find it necessary to sell them at lower prices.

It is a quite general practice to deduct the price of the shoes purchased from the pay envelope, usually the whole amount, though in some cases, only a part of the amount is deducted each week. In some cases, it is a rule to deduct the amount from the pay envelope, while in others, the man has his choice of paying cash or having the price deducted from his pay. In other cases, all shoes are sold either for cash or the man pays for them as soon as he gets his pay. The stock is usually kept in the stockroom most conveient for the men.

Ford Motor Company
FOUNDRYMEN TAKE WARNING
Why Wear Poor and Unsafe Shoes like these
And have to endure the torture of a frightful burn like THIS?
Wide-awake, Careful Foundrymen wear Shoes that are specially made for their work like these
You Must Act Now Before It Is Too Late


The Aluminum Bulletin
HOT BATH
HOT BATH RAN IN HERE
LACED SHOE, NO TONGUE
"CONGRESS" SHOE
SHOE THE MAN WORE
Safety First or Safety Last, Which?
By J. J. Lamb.
Number of Lost Time Accidents per 100 Men Employed, 1919

SHOP BULLETINS, HOUSE-PUBLICATIONS AND ALL THE BEST KNOWN METHODS OF FACTORY PUBLICITY SERVE TO IMPRESS THE NECESSITY FOR PROPER CLOTHING IN HANDLING HOT METAL

Analyze Loss in Aluminum Shops-III

Conditions at Several Typical Foundries Described, Including Melting Equipment and Operation Molding Methods and Inspection Routine — Pyrometric Control Varies in Different Foundries

BY ROBERT J. ANDERSON

CASTING losses in the production of aluminum-alloy sand castings vary markedly in different foundries depending upon numerous factors and local conditions. In studying the problems involved in determining the casting losses in aluminum-foundry practice, numerous foundries in the United States were visited by the writer for the purpose of examining the available production records, inspecting the daily production of individual castings, and investigating general conditions at individual plants. The data furnished in the replies to the questionnaire were thus supplemented by direct observation of actual working conditions, and the personal visits served to clear up some points of interest not brought out by the replies. The analysis of the replies to the questionnaire together with data which show the trend of the casting losses in aluminum founding are given later. In order that the production records, subsequently given, and the casting losses at individual foundries may be intelligently interpreted, it is necessary to describe in some little detail the conditions at several typical foundries.

* * *

Conditions at Foundry A

GENERAL conditions at Foundry *A* were as good as in any of the foundries investigated, and better than in most. This foundry is equipped with the best available labor saving machinery, and is classed as a model foundry for the production of aluminum-alloy castings. The class of work is largely repeat jobs, motor crankcases being the main output. Like the majority of foundries at the present time, this foundry melts No. 12 alloy only, using that alloy for all castings. The melting is done in a battery of oil-fired cast-iron melting pots of 600 pounds capacity. There are two pots to a furnace bank. A small percentage of the metal is melted in a barrel-shaped Schwartz open-flame furnace, fired by gas, but all the castings for which casting losses have been tabulated, were poured from metal melted in the iron-pot furnaces. In this foundry the endeavor is made to always maintain the molding in advance of the melting. The average melting charge for the castings tabulated consisted of the following:

25 per cent No. 12 scrap
25 per cent No. 12 ingot
50 per cent virgin aluminum ingot plus the necessary amount of 50:50 alloy

The No. 12 scrap in the charge was made up of scrap from the foundry, and outside No. 12 scrap consisting largely of airplane parts. The No. 12 ingot consisted of ingot secured by running down borings from the machine shop. It has been found economical in this foundry to ship the machine-shop borings to an outside smelter for conversion into ingot. The borings are run down for a smelting fee and returned to the foundry. It also has been found economical by this foundry to purchase the 50:50 alloy from outside sources. As previously pointed out, the molds are kept waiting for metal as much as possible, so

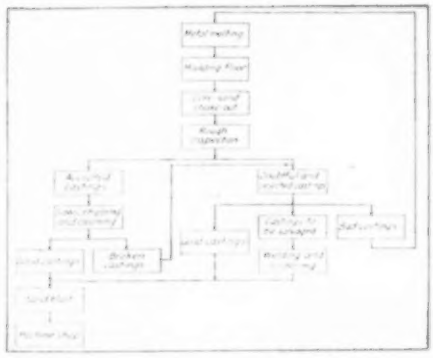


FIG. 1—DIAGRAMMATIC SKETCH OF FLOW OF CASTINGS THROUGH FOUNDRY *A*

that the pots are ladled out as soon as ready. The metal is heated about 815 degrees Cent. (1500 degrees Fahr.), and temperatures are taken frequently with a base-metal thermocouple of a special type.

Melter Supervises Operations

About 100 pounds of molten metal is kept in each pot, and after the cold metal which has been charged, is run down, approximately four ounces of zinc chloride are sprinkled on top of the liquid melt. The accumulated dross is then skimmed off. After allowing the melt to stand for about five minutes, it is stirred well with an iron spoon and additional dross is removed. The first dross removed is flaky, dirty, and fine, but the second dross is metalic, viscous, and heavy, and contains considerable entrained aluminum. When the copper in No. 12 alloy is running high, as for example, when much piston and manifold scrap is charged and sufficient aluminum is not added to dilute it, casting difficulties are experienced on the molding floor because of cracked castings. Where the method of molding has been worked out satisfactorily in this foundry for castings of No. 12 alloy, the same method of molding is found to be unsuitable for an alloy of 90:10 aluminum-copper. It is believed also, in this foundry, that high copper in No. 12 alloy hastens the formation of scale (the complex iron-aluminum alloy) in iron-pot melting, and that hard spots are more prevalent when the copper is high. The iron melting pots at this foundry are handy to charge and ladle, as they are built in pits, the top of the pots being about 2 feet from the floor level. Close attention is given to the make-up of charges, and a well paid melter is employed to supervise the charging, melting, skimming, and ladling, including firing and taking temperature readings. Metal is removed from the pots for casting by ladling with iron dipping ladles into larger iron carrying ladles. The latter are carried to the molding floor by hand. During ladling, additional dross forms by the exposure of the liquid metal to the air, and this dross is skimmed off before pouring. Actual pouring temperatures are not taken.

Rigid Inspection

In the case of the crankcase job, for which statistics of losses are given later, power-machine molding is used largely, and the molding equipment is of the most modern type. After pouring the castings, they are shaken out by pulling off the boxes with the hoist of a traveling crane. The rough castings are carried to the cleaning room on trucks. Core sand is loosened by a vibrating air hammer. The castings are then cleaned of gates and risers. Rough inspection is carried out at various stages. Any doubtful casting is placed in a temporary scrap pile. The passed castings are immediately sent to the chipping room. Any castings broken on chipping are placed in the temporary scrap pile, and at the end of the day the accumulation of defective castings in the temporary scrap pile is re-inspected. During this re-inspection, the daily production record is made out. Castings which can be salvaged by welding or soldering, the accepted castings, and the totally defective castings are separated in three piles. All accepted castings, including those which have been salvaged, are sent to the sand blast and finally to the machine shop, while the totally defective

castings are returned to the melting room. A diagrammatic outline of the flow of castings through this foundry is shown in Fig. 1. The final inspection is performed by the assistant superintendent and three foremen, with a clerk to record the data. After the production record for the day is made out, a conference is held on the nature of the losses and what immediate steps shall be taken to correct the errors. The method of inspection in this foundry appears to be effective, and it may be taken as a model along inspection lines for foundries having a large production of but few types of castings. The daily melting capacity of this foundry is rated at about 35,000 to 40,000 pounds of metal, with a production of 500 finished crankcases and a minor amount of other castings, largely repair parts.

Periodic Samples Analyzed

One of the main general reasons for casting losses in Foundry *A* is the fast production methods, and losses due to handling, molding errors, and breakage are liable to be higher than normal under such conditions. The entire labor force is paid on a piece rate basis for accepted castings, no pay being allowed for defectives which cannot be salvaged. Labor turnover was not particularly high for the period of time during which the scrap-loss statistics were taken. Metallurgical control is fairly good and maintained at a satisfactory level as regards pyrometry, chemical analyses, and physical tests. All melting materials and periodic samples taken from the pots are analyzed.

The casting losses in Foundry *A* vary from 3 to 14 per cent, with an indicated average of about 7 per cent, according to the questionnaire reply. In considering the data given in the replies to the questionnaire, there has been found evidence of a desire to put the best foot forward, but due allowance has been made for this tendency in arriving at an average figure for casting losses in all foundries.

Monetary values of the casting losses in Foundry *A* may be readily estimated on the basis of output, the average percentage of loss, and the cost of a scrapping a pound of casting. The following figures serve for this purpose:

Total annual output, finished castings	9,500,000 pounds
Average casting loss	7.0 per cent
Cost of 1 pound of scrap casting	12.5 cents

The cost of a pound of scrap casting is arrived at in this foundry by a usual operation type of cost system, i. e., by allocation of foundry expense to labor.

With the figures given, the annual monetary loss sustained in this foundry may be calculated as follows:

9,500,000 (weight of finished castings) ÷ 0.93 (per cent good castings) = 10,215,054 (total weight of castings)

10,215,054 x 0.07 (per cent defective castings) = 715,054 pounds loss

715,054 x $0.125 (cost of 1 pound of scrap) = $89,382

This gives an annual loss of $89,382 on the basis of an average casting loss of 7 per cent, which is a somewhat low figure. If the average losses could be consistently reduced 50 per cent, it would mean an annual saving of about $45,000. Late reports from this foundry indicated that the losses for several months have been reduced to 4 per cent by increasing the quality of the supervision.

* * *

Conditions at Foundry B

THE next foundry at which casting losses were investigated

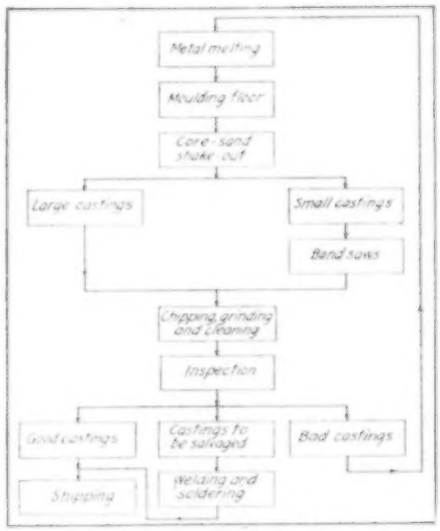


FIG. 2—DIAGRAMMATIC SKETCH OF FLOW OF CASTINGS THROUGH FOUNDRY *B*

was one which may be called a jobbing foundry of moderate size. Some fairly large production jobs are usually in the shop but a miscellaneous lot of castings also are made. This foundry makes brass and bronze castings in addition to aluminum-alloy castings. The largest repeat jobs include crankcases, oil pans, carburetor bodies, manifolds, radiator housings, and other castings for motor cars, but the companies to which these castings are supplied, do not make a large number of cars in a year. No. 12 alloy is melted mainly, but some 90:10 aluminum-copper alloy is cast for intake headers. The melting is done in a battery of oil-fired cast-iron circular melting pots of 450-pounds capacity. Each pot is set in a separate furnace. Some metal is melted at times in a barrel-shaped, gas-fired, Schwartz-type furnace of 1000-pounds capacity. The data for casting losses in the production of various types of castings have been taken on melts in the iron pots. The relation between molding and melting is not well worked out in this foundry, and due to confusion at times, metal may be held too long before the molds are ready. Melting charges are quite variable. During 1919 the melts were made largely from all-airplane scrap charges which yielded excellent results in the opinion of the foundry officials. In ordinary times, an average melting charge is considered to be as follows:

25 per cent No. 12 scrap from outside sources
30 per cent No. 12 foundry scrap
45 per cent primary No. 12 ingot

The No. 12 scrap from outside sources consists largely of automotive scrap and miscellaneous castings. The No. 12 foundry scrap is mainly sprues, gates and risers, and defective castings made in the foundry itself. The No. 12 primary ingot is purchased from producers of virgin aluminum ingot, and made from virgin ingot plus copper. When necessary to use aluminum ingot in the manufacture of No. 12 alloy for casting purposes, this foundry prefers to introduce the copper by adding electrolytic sheet copper. The scrap-loss statistics given later apply to castings poured from all-airplane scrap charges in general, but some were poured from the average charge given above. Not much machining is done in the small machine shop connected with this foundry, and the accumulation of aluminum borings is small. These are sold in the open market.

Production Not Rushed

Temperatures of the melting pots ordinarily are judged by eye, except that the foundry foreman uses a pyrometer about once a month to check up the eye of the melter. Control of melting and pouring temperatures is therefore exceedingly poor. A molten heel of 50 to 100 pounds of liquid metal is retained in each pot, and after the cold metal charged has been melted, the heat is fluxed with zinc chloride in the usual way. The melting pots are run until they break through in contradistinction to practice in Foundry *A*, where the pots are run for a definite number of melting hours and then removed. The melting rate is usually about six heats per pot per nine hours. The pots are thoroughly scraped out at night and cleaned of dross and adhering scale. If this is neglected, rejections because of hard spots in the castings run high. The melting supervision in Foundry *B* is not so good as in Foundry *A*. The liquid alloy is ladled out with iron dippers into plumbago crucibles for pouring large castings, and small iron hand ladles are used for pouring smaller castings. The metal is carefully skimmed. Actual pouring temperatures are not taken. Molding is done by power machines, hand machines, or on the bench or floor, depending upon the size and type of casting. All shaking out is done by hand, except in the case of crankcase and oil-pan work, where the cope and drag are removed by a jib crane hoist.

Castings are handled by hand and wheelbarrows, and the rate of production is not rushed with anything like the intensity of that at Foundry *A*. The majority of castings are taken by wheelbarrow to a core-sand knock-out room, where the core sand is loosened by sledges and hand hammers, and then removed by hand.

After rough cleaning, the castings are sent to the band saw where gates and risers are cut off. From here they are taken to the chipping and cleaning room. All castings poured pass eventually over an inspector's table. The good castings are sent to the shipping department, the defective castings are returned to the melting room, and castings having remediable defects, are welded or soldered. The production record is made out by the inspector during the course of inspection, but the record is not carried into any amount of detail and serves largely for making up the pay-roll in piece work. A diagrammatic outline of the flow of castings through the foundry is depicted in Fig. 2. The daily melting and molding capacity of this foundry is placed at 14,000 to 18,000 pounds of metal. The officials state that in their opinion one of the main reasons for casting losses in their plant is the large labor turnover which was very heavy during the time covered by the scrap-loss statistics furnished.

Metallurgical Control is Poor

In the opinion of the writer, the losses may be traced more directly to the inaccuracy of the production records which do not permit adequate diagnosis of the losses to be made. Losses are due, as in other foundries, to molding errors, carelessness and rush work. The labor force is on a piece-rate basis largely, no pay being allowed for defective castings. A more liberal interpretion of what are to be construed as allowable and what as not allowable defects is made in this foundry than in Foundry *A*. Metallurgical control is poor as regards pyrometry and chemical analyses. Tensile test bars are pulled on samples cast at random during the day, say morning and night. Melting materials are not analyzed chemically nor are pot samples analyzed ordinarily, there being no chemical laboratory attached to this foundry. On the whole, general conditions in Foundry *B* may be regarded as fair, but improvements are possible in many directions. Casting losses vary from 3 to 18 per cent, with an indicated average of about 10 per cent, according to the questionnaire reply.

However, losses as shown by the production records for a period in 1919 averaged 12 per cent, with higher losses at intervals.

The following figures are employed for estimating the monetary value of the casting losses sustained in this foundry:

Total annual output, finished castings	4,000,000 pounds
Average casting loss	10 per cent
Cost of 1 pound of scrap casting	12.5 cents

With the figures given, the annual monetary losses in the foundry may be calculated as before:

4,000,000 (weight of finished castings) ÷ 0.90 (per cent good castings) = 4,444,444 (total weight of castings)

4,444,444 x 0.10 (per cent defective castings) = 444,444 pounds loss

444,444 x $0.125 (cost of 1 pound of scrap) = $55,556

This gives an annual loss of $55,556 on the basis of an average casting loss of 10 per cent. If the average losses could be reduced to 50 per cent, which would be possible in this foundry, with less labor turnover and sufficient attention paid to diagnosing the causes for losses, the indicated annual saving would be $28,000.

* * *

Condtions at Foundry C

THE third foundry investigated is one making aluminum-alloy, brass and bronze, and gray-iron castings. This foundry is a department of a large motor-car corporation. The output consists of castings for motor-car construction, but no long periods of production for a particular casting are maintained. An alloy approximating No. 12 in composition is used for all aluminum-alloy castings made. The melting is done in six rectangular cast-iron pots and two circular pots, both types being fired by oil. The capacity of the former is 720 pounds, but usually the cold charge is 600 pounds—that amount of metal being added to a 100-pound heel. The capacity of the round pots is 250 pounds, and a cold charge of 200 pounds is added to a 50-pound heel. The melts are maintained at about 815 degrees Cent. (1500 degrees Fahr.), and temperatures are taken frequently with a base-metal thermocouple. Temperatures are regulated quite closely in this foundry, but the actual pouring temperatures have been variable in the past, ranging between 1250 and 1550 degrees Fahr., and at times even higher. An attempt had been made to pour different kinds of castings at different temperatures, but at the time of the investigation all castings were being poured at approximately 1500 degrees Fahr. The average melting charge during the period covered by the scrap-loss statistics consisted of 50 per cent No. 12 alloy scrap, and 50 per cent virgin aluminum ingot plus copper.

The No. 12 alloy scrap consisted of sprues, gates, risers and foundry defectives, and some airplane scrap. The remainder of the charge was composed of virgin aluminum ingot plus copper punchings and clippings. Like charges in other foundries, the melts have been variable as to make-up, varying from all-virgin metal plus copper to 100 per cent No. 12 scrap. Usually, according to the records, the charges vary between 30 and 60 per cent No. 12 scrap, and the remainder virgin aluminum ingot plus the required amount of copper.

The usual practice of fluxing with zinc chloride is followed. Metal is removed from the pots for pouring large castings by ladling with iron dippers into plumbago crucibles which are carried by hand to the molds. Small castings are poured from an iron hand ladle. As already stated, actual pouring temperatures are not taken. Jobs are molded by power machine, hand machine, on the bench, and on the floor, depending upon the size and kind of the castings. Molding equipment, including machines, box and flask equipment, and patterns, is in fair condition. The castings are shaken out of the molds by hand, except in the case of the large ones, where boxes are loosened by raising them with a chain hoist. After being shaken out of the molds, the castings are removed by truck to a core-sand knock-out room. All small castings are sent to the band-saw and grinding departments, and large castings go to the chipping and cleaning room. Production records have been kept in a loose fashion in this foundry. Rejections have been made at the band saws and in the chipping department without keeping a record of the defectives. Small castings pass over the inspector's table after cleaning and grinding, and the final inspection there covers the entire inspection given to these jobs after grinding, cleaning, welding, and repairing. Large castings are given a rough inspection to determine what castings can be salvaged. This is done after the castings come from the chipping department. They are then given a final inspection after repairing, but the records are in poor condition. The variety of castings made, together with the fact that specific jobs are kept in production for only a few days at a time, as well as the laxity in following the scrap makes the data furnished uncertain. Moreover, the inspection records available are not carried out in any detail. Wages paid to molders are on a piece rate basis. The daily melting and molding capacity of this foundry is rated at 15,000 pounds with a production of 10,000 pounds of finished castings.

Variable Production Methods

It is difficult to analyze the reasons for scrap losses in the foundry because of the inaccuracies of the records. One of the main reasons is connected with the variable production methods, the work being typical of that done in a jobbing foundry. A molder will be set to work on a given casting and after working three or four days on that job he will be given an entirely different job. Thus the molder never becomes really familiar with the pecularities of any one job.

In this case the metallurgical control is reasonably good as regards pyrometry, chemical analysis, and physical tests. All melting materials are analyzed, and periodic samples are taken from the melting pots for analysis. Physical tests are made frequently. Casting losses vary from 2 to 12 per cent with an indicated average of 8.1 per cent, according to the questionnaire reply. Losses shown by the production records in 1919 averaged 11 per cent, and varied from 3 to 24 per cent. Monetary losses because of defective castings are estimated as follows:

Total annual output of finished castings	3,000,000 pounds
Average casting loss	8.1 per cent
Cost of 1 pound of scrap casting	11 cents

With the figures given, the annual monetary losses in this foundry may be calculated as in the previous cases:

3,000,000 ÷ 0.91 = 3,296,703
3,296,703 x 0.081 = 267,033 pounds loss
267,033 x $0.11 = $29,374

This gives an annual monetary loss of $29,374 on the basis of an average casting loss of 8.1 per cent, and substantial savings could be effected if the average losses were reduced.

* * *

Conditions at Foundry D

FOUNDRY *D* is a plant devoted to the production of vaccum-cleaner castings in aluminum-alloys, and the conditions are consequently somewhat different than are those in foundries making automotive castings. Conditions in Foundry *D* may be regarded as fair from the molding standpoint; the quality of the supervision is reasonably good; labor turnover is low; but metallurgical control is poor. The castings are all small, the heaviest one made weighing 2.5 pounds. Inasmuch as all castings for vacuum cleaners must be highly polished, certain factors which affect casting losses are especially emphasized in this foundry. The work is largely repetitive. No. 12 alloy is used exclusively. Melting is done in stationary iron pots, with closed covers, fired by oil, and in oil-fired crucible furnaces. The average melting charge is 50 per cent primary aluminum ingot plus the required amount of 50:50 alloy, and 50 per cent foundry scrap.

No scrap is used other than that originating in the plant. The metal is heated to about 871 degrees Cent. (1600 degrees Fahr.), but no melting-furnace temperatures are taken. Because the castings are thin in section and some of them are of rather intricate design, the metal is poured rather hot. In crucible melting at this foundry, 90 pounds of metal are charged and poured at a time. In iron-pot melting, a molten heel of about 80 pounds is kept in the pot, and the cold charge is about 200 pounds, although the practice of continous charging, so as to keep pace with the rate at which hot metal is removed, is also employed. No flux is used either in the melting furnaces or in the pouring pots, but both are carefully and frequently skimmed of accumulated dross. Metal is removed from the iron pots by ladling with iron dippers into plumbago-clay crucibles for pouring, but some small castings are poured directly.

Small Castings

Bench molding predominates, but some hand machines are used for certain castings. All castings are shaken out by hand, and the core sand is knocked out in a separate room. The gates are cut off at the band saw or on a sprue cutter, and the castings are then ground and filed. No chipping is done because the castings are all small. Some rejections are made of defectives at the band saw and sprue cutter, but these rejections appear in the records. The cleaned castings are inspected on tables in the ordinary way, all defectives being returned to the melting department. The daily melting capacity of this foundry is placed at 5000 pounds of metal with an output of 2500 pounds of finished castings. Machine shop returns average 2 per cent, but are often higher due to polishing difficulties and hard spots.

One of the main reasons for casting losses in this shop is the character of the castings made. Metallurgical control, as already stated, is not at a satisfactory level, and excessive variations were observed in the chemical composition of the alloy. Pyrometry is utilized, and temperatures of the pouring pots are faithfully taken. The high pouring temperatures necessary may increase the losses because of cracks and porosity. On the whole, general conditions in Foundry *D* may be regarded as fair when referred to average conditions throughout the industry, but many improvements are possible. The casting losses in this foundry vary from 5 to 11 per cent, with an indicated average of 8 per cent. On the usual basis, monetary values of the losses as calculated are as follows:

Total annual output, finished castings	720,000 pounds
Average casting loss	8 per cent
Cost of 1 pound of scrap casting	25 cents

With the figures given, the monetary loss, calculated according to the method previously employed, is:

720,000 ÷ 0.92 = 782,609
782,609 x 0.08 = 62,609 pounds loss
62,609 x $0.25 = $15,652

* * *

Conditions at Foundry E

THIS foundry produced automotive castings mainly, but vaccum-cleaner parts and small commercial castings are also made. Foundry *E* is a new modern aluminum foundry, equipped with the best available labor-saving equipment. The work is largely repetitive. Both No. 12 alloy and a ternary aluminum-copper-zinc alloy (78:3:19) are cast, but the latter forms only about 4 per cent of the total production. Melting is done in tilting cast-iron pots and in reverberatory furnaces. The former have a capacity of 400 pounds and the latter are of 4000-pounds capacity. An average melting charge is made up as follows:

35.0 per cent foundry scrap
25.0 per cent secondary No. 12 ingot
33.6 per cent primary aluminum ingot
6.4 per cent 50:50 rich alloy.

Melting temperatures are variable. They are maintained at about 815 degrees Cent. (1500 degrees Fahr.), in the iron pots, but are likely to run considerably higher in the reverberatory furnaces. In iron-pot melting, the pots are emptied completely after each heat, no heel being retained. The reverberatory furnaces are charged more or less continuously and are employed largely on scrap melts, especially for melting large scrap castings which can be charged without being broken. No flux is used, either in the furnaces or in the pots. Pouring is done mainly with crucibles. Pouring temperatures of the metal in the crucibles are taken on the way to the molds with an unprotected base-metal thermocouple. Cold gates are added if the metal is too hot, which is usually the case.

Molding is done on power machines, hand machines, on the bench and on the floor, depending upon the kind of castings made, and the molding equipment is of the modern type. Molds are shaken out by crane or hand, and the rough castings are trucked to a core knockout room. Additional retails as to conditions are quite similar to those described for Foundry *A*. Fast production methods are the rule in this foundry, and losses because of molding errors, core troubles, handling and the like, are large. Labor turnover is high. This together with the greater variety at castings produced in Foundry *E* accounts for the higher casting loss experienced here than in Foundry *A*. Metallurgical control is is fairly good and is maintained at a satisfactory level as regards pyrometry, chemical analysis, and physical tests. On the whole, general conditions in Foundry *E* may be considered to be good, but they are not so good as in Foundry *A* from the standpoint of casting losses and the factors affecting them. The casting losses in Foundry *E* vary from 8 to 20 per cent, with an indicated average of 14 per cent. Monetary values of the losses are estimated in the usual way as follows:

Total annual output of finished castings	12,000,000 pounds
Average casting loss	14 per cent
Cost of 1 pound of scrap casting	10 cents

12,000,000 ÷ 0.86 = 13,953,488
13,953,488 x 0.14 = 1,953,488 pounds loss
1,953,488 x $0.10 = $195,345

Possibilities for large annual savings in Foundry *E* through the reduction of the percentage of scrap losses are apparent.

How and Why in Brass Founding

By Charles Vickers

Acid in Copper Ingot Is Pronounced Harmless

We have been using both lake and electrolytic copper ingots and do not find any particular difference except the electrolytic is lower in price. We are informed, however, that the lake copper contains arsenic acid, and as our metal goes into cooking utensils, we would of course, want to avoid this. Will you please advise us if lake copper contains arsenic acid, also if the same acid is found in electrolytic copper.

Lake copper sometimes does contain a small amount of arsenic but this is not sufficiently high to cause any difficulty when the metal is used to make cooking utensils. If the arsenic was oxidized to the acid, this would occur during the time it was molten, and the oxide being nonmetallic would rise to the surface of the copper and be skimmed off, or would break away as a brittle substance when the copper cooled.

Electrolytic copper rarely contains arsenic in appreciable quantiy. We suggest that the question of arsenic being present to the detriment of the metal as a material for food containers be dismissed from consideration, as in any case the amount is too small to be harmful.

Lead in Bearing Alloys Decreases Wear

We are operating a small brass foundry making locomotive and other castings for steam railroads, but are not getting the service from our brass castings that we desire. The mixture we are using for driving boxes is as follows: Copper, 78 per cent; tin, 10 per cent; lead, 12 per cent. We use three-fourths scrap and one-fourth new metal.

Will you state if this is sufficient new metal, also the reason for using lead in these castings? What would be the effect if it was left out? Please give a formula suitable for driving box brasses for a heavy type of engine.

A number of years ago alloys of copper and tin with a little zinc and lead were used almost exclusively for driving brasses, a typical alloy being as follows: Copper, 87 per cent; tin, 12 per cent; zinc, 0.5 per cent; lead, 0.5 per cent. It also was quite common to omit the lead entirely and substitute zinc. Sometimes as much as 2 per cent zinc was included in the alloy. These hard bronzes have been superseded by alloys containing a relatively large amount of lead, such as the one mentioned by you, because it was discovered that the wear of the bearing decreased with an increase of lead content. In a paper read before the Franklin Institute in 1903, G. H. Clamer describing a research he had undertaken gave the figures as shown in the accompanying table.

Effect of Adding Lead to Bearing Alloys

Copper per cent	Tin per cent	Lead per cent	Friction in lbs.	Temperature above room	Wear in grammes
85.76	14.90	.....	13	50	0.2800
90.67	9.45	.....	13	51	0.1768
95.01	4.95	.....	16	52	0.0776
90.82	4.62	4.82	14	53	0.0542
85.12	4.64	10.65	18.5	56	0.0380
81.25	5.17	14.14	18.5	58	0.0327
75.00	5.00	20.00	18.5	58	0.0277
68.71	5.24	27.67	18	58	0.0204
64.31	4.70	31.32	18	44	0.0130

A study of this table will show that the wear decreases with the increase of lead. This is the reason for using lead in these bearings. The mixture being used by you might be criticised as a little too soft for the service. The following alloy would be better, both for the regular castings and the driving brasses for the heavy-type engines: Copper, 76.75 per cent; tin, 11.50 per cent; lead, 11.50 per cent; phosphor copper containing 15 per cent phosphorus, 0.25 per cent.

Care should be exercised when using scrap to see that only scrap of the same composition as the alloy is used otherwise a totally different mixture from what is desired may result.

Avoiding Brass Shakes

The writer who is a brass-foundry foreman has found when operating both oil and gas-fired furnaces that attacks of sickness have come on which made it necessary to stop using these furnaces. On reaching home at night chills would develop. Several of the molders have experienced the same thing, although, otherwise we are apparently in the best of health. Do you consider this is caused by the fumes and smoke, or on account of poor ventilation?

The sickness is known as *brass shakes*, or *brass founders ague*, and is due to the fumes of zinc. Quoting from "Brass Furnace Practice in the United States" page 259, "There is no specific remedy for these shakes, but hot milk, milk and eggs, and milk and pepper, taken in large quantities, and the use of mild purgative shorten the attack and decrease its severity. This treatment also may ward off an attack." The gas and oil-fired furnaces may be the cause of the sickness, but this condition can be remedied by placing hoods over the furnace to carry off the fumes. These hoods will at the same time provide ventilation. No furnaces free from stack connections ever should be allowed to operate in any confined space, for aside from the fumes of zinc, other deleterious gases are given off and the health of the workers will be sure to suffer. The brass shakes, themselves, are not considered dangerous. However, they are unpleasant, and unpleasant things of this kind always should be avoided. Until hoods are installed some relief can be obtained by tying handkerchiefs over the nose and mouth. It is beter to use regular respirators.

Bearings for Hot Rolls

We would like to get a mixture suitable for bearings for hot plate rolls.

An alloy suitable for the above purpose follows: Copper, 77 per cent; phosphor copper, 3 per cent; tin, 10 per cent; lead, 10 per cent. This forms the standard phosphor bronze for high speed and heavy pressure, and is extensively used for bearings subjected to shock and vibration, heavy work and high speeds, such as crank pins, roll necks, bridge bearings and other bearings.

Chemist Controls All Iron Mixtures

Melting Department in the Foundry of a Large Plant with Diversified Output Regulated by the Laboratory with Little Red Tape— Inclined Skip Hoist Charges Cupola

SYSTEM is essential in any great organization, for if operations are not so co-ordinated that every member making up the whole knows his exact duties and prerogatives he is likely to act beyond his authority and throw part of the machinery out of gear. Not so much is thought of the limits placed on individual initiative by the necessities of a huge company, by those who have worked in such surroundings during all their experience. However, the executive, who has been accustomed to a small shop and then is moved to be a cog in the wheel of some vast industrial machine, frets under rules and routine which at first seem an unnecessary hinderance.

Complexity of organization is not measured entirely by the size of a company but rather diversity of operations and output are a highly contributing factor. A foundry making one line of castings for a controlling company which pays little attention to specifications can operate with a much simpler system than the one producing a wide variety of castings to specifications drawn by different engineers. Therefore, many foundries do not realize what conditions are encountered by some companies. The general manufacturing company making a diversified line of machinery with an engineer in charge of the design of each branch must have system in its foundry to produce satisfactory results. Then the problem is to simplify the routine so that it is as simple and flexible as possible. A good example of this is found in the Allis-Chalmers Mfg. Co., Milwaukee, which manufactures a wide variety of crushing, electrical, mining, saw mill and flour mill machinery in addition to pumps, turbines, gas and oil engines, steam engines and tractors.

Special Metals Required

In all these classifications there are castings which require special metal to meet the physical conditions peculiar to the particular work of the machine. This, together with the variety of sizes of the castings demands a number of different mixtures in the foundry. In fact, some of the crusher parts which must be chilled iron must be made of iron with such peculiar properties that foundries have been established by the Allis-Chalmers company for making only this class of castings. One of these foundries in which the metal is melted in an air furnace will be described in an early issue of THE FOUNDRY.

The importance attached to the foundry work of this company is indicated by the fact that one of the two assistant general works managers, A. E. Harrison, is a foundryman and is in general charge of all its foundries and pattern departments. Under his direction these departments are operated by a superintendent, a general foreman and sub-foremen. Working in close accord with this organization is the chief chemist, R. S. McPherran, who has charge of the laboratory work of the entire company and also acts as a go-between for the engineering department and the foundry. He advises the engineers what kind of iron should be specified for the different castings and then calculates the foundry mixtures and tests the iron to see that the quality of each mixture is as desired.

Storage is arranged to expedite the efforts of the metallurgical department. The stockyard is located along one side of the foundry, shown to the right in Fig. 1. Pig iron, coke and limestone are brought in the railroad cars on a track extending along one side of the yard as indicated to the left in Fig. 1. A crane runway extends along the entire 1200-foot length of the foundry and on beyond to the hard-iron shop, covering a distance of more than a half mile. The width of the span of this runway

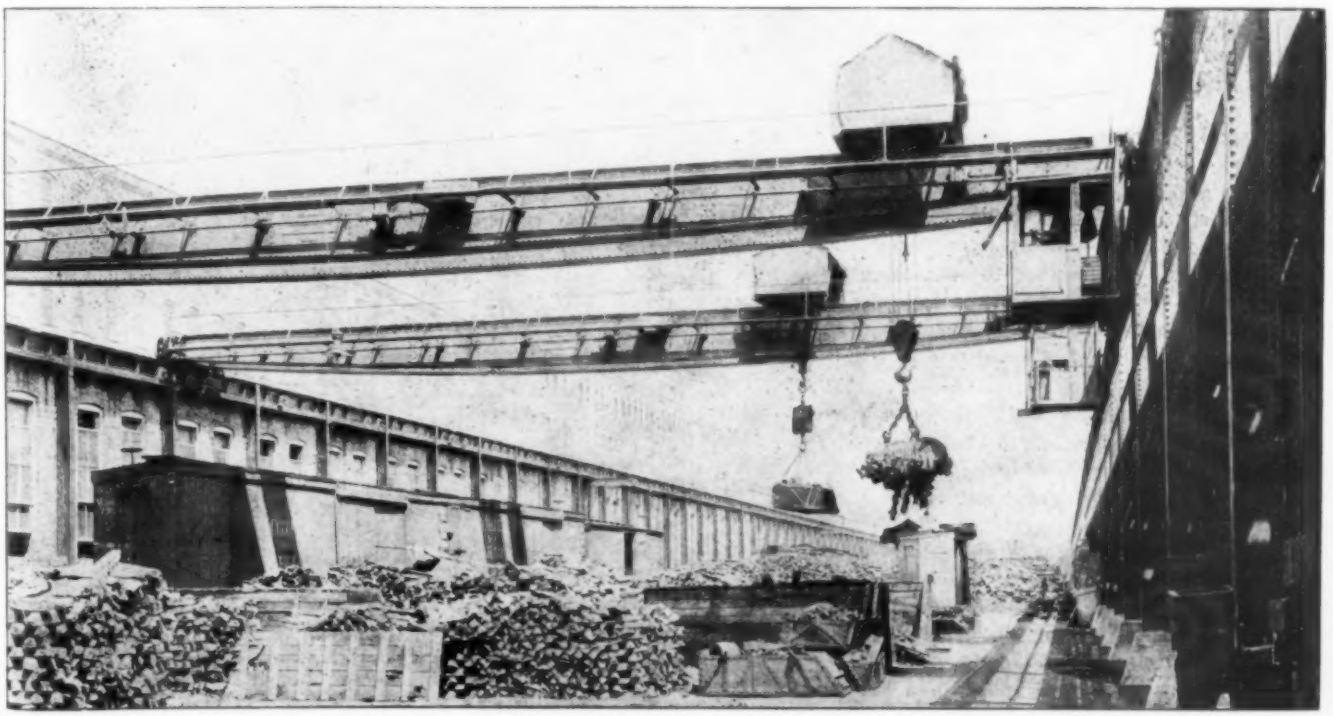


FIG. 1—A CRANE RUNWAY COVERS THE STOCK YARD AND METAL IS HANDLED BY A MAGNET— COKE IS UNLOADED NEAR THE CUPOLAS—PIG IRON IS CARRIED IN SKIPS AND WEIGHED BY A SCALES ATTACHED TO THE CRANE

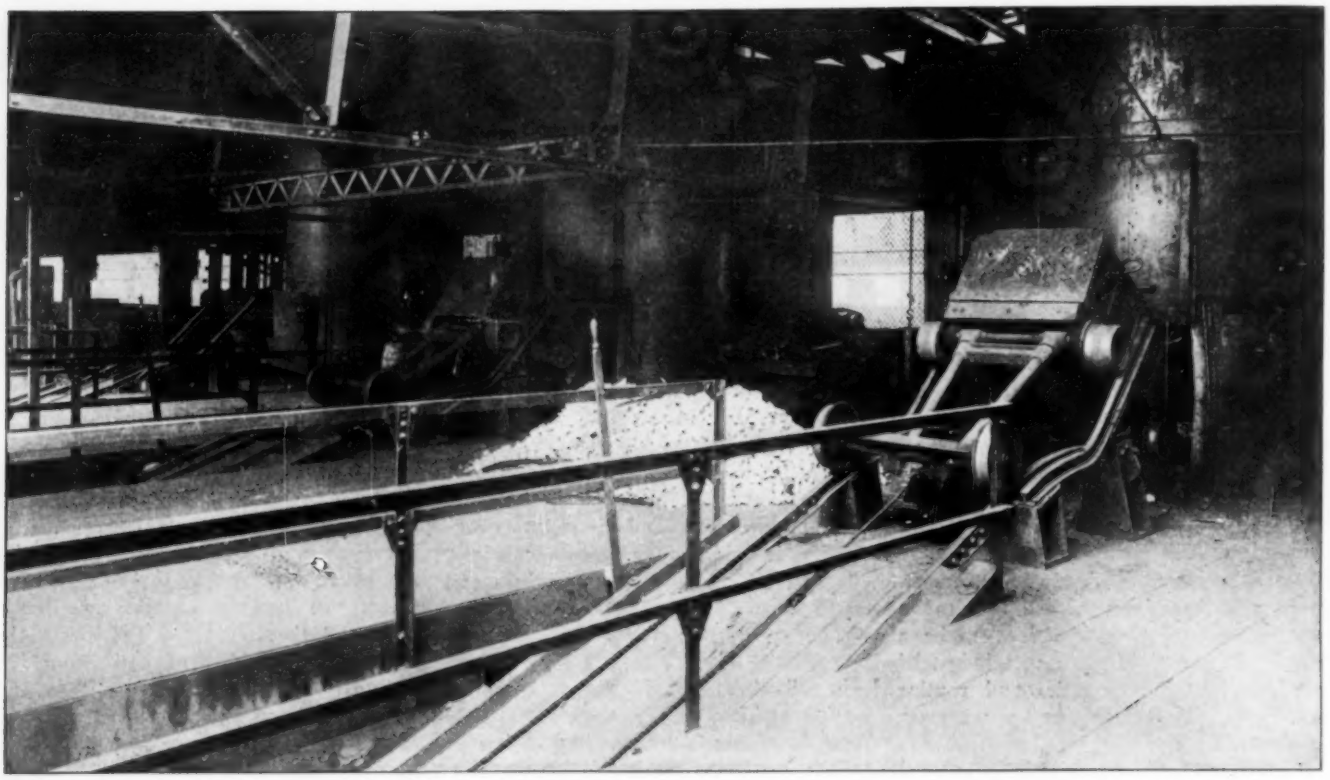


FIG. 2—THE BUGGY OF THE HOIST IS RAISED BY A SECOND TRACK WHICH ENGAGES THE WIDE TREADS OF THE MIDDLE WHEELS—A SAFETY DEVICE PREVENTS THE BUGGY FROM TRAVELING TOO FAR

is 80 feet. As may be noted in Fig. 1 a magnet is employed for handling the pig iron and scrap. Each car is analyzed when received and the average between the results secured by the company's chemist and those reported by the furnace is used in calculating the mixture.

As was noted, a number of mixtures of iron are used. Altogether there are six or eight standard compositions of metal and every day more than one mixture is put into the cupolas. Orders for castings are received by the foundry with the grade of iron desired by the engineer in charge of the particular line of work for which the casting is to be used, specified on the order. Each morning the sub-foremen calculate how much iron of the different grades will be needed by them and report it to the general foreman who notifies the chief chemist. From this information the latter indicates how many charges of each mixture should be placed in the cupolas.

Should the engineers call for a special grade of iron in a casting which the chief chemist considers unsuitable for the work a conference is called between the engineers, the foundrymen and the metallurgist. In this way the parties interested in each casting are in close touch with any changes which it may be decided to make in the iron being put into it.

Coke, as it is received, is piled in a bin near the cupolas. By-product coke is preferred by this company and it is secured when possible to obtain it. To make the best grades of by-product coke certain mixtures of coal are necessary and as the coke companies were not able at all times lately to secure the grades of coal they desired some rather poor coke was received at times. Under these conditions it was found that the addition of anthracite coal to the coke charged into the cupola proved an advantage. However, with normal coke the addition of the coal is not found to be beneficial.

Pig iron is also kept as near the cupolas as possible to facilitate charging. It is loaded into skips carried by a crane which is equipped with a scale so that the loader may weigh the iron as he fills the basket. A few of these skips are loaded and stored in the yard

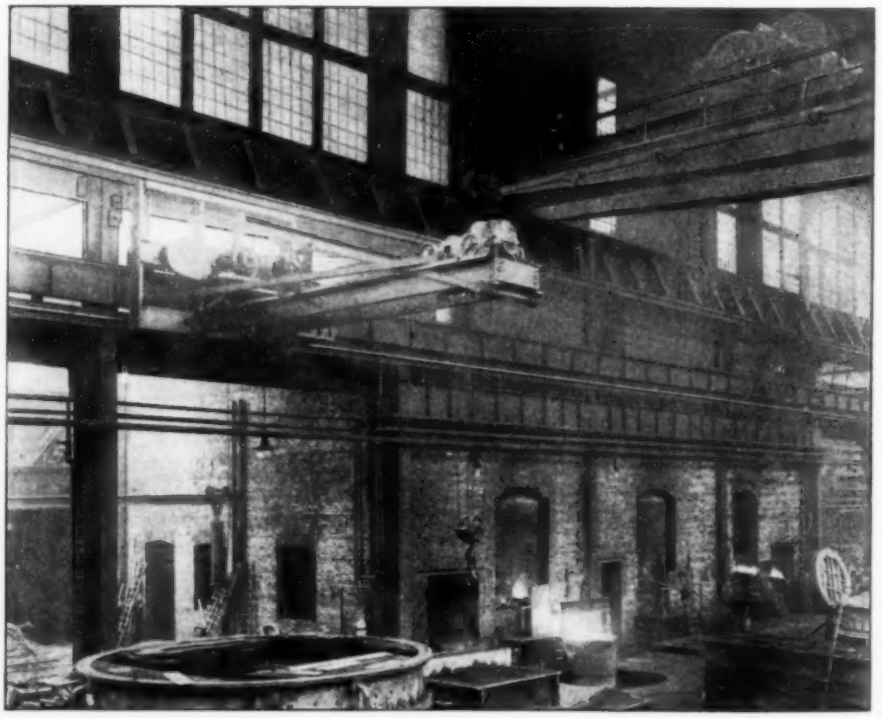


FIG. 3—THE CUPOLAS ARE BRICKED OFF FROM THE MAIN FOUNDRY—METAL IS CARRIED TO THE MOLDS BY WALL CRANES AND BY THOSE TRAVELING ON THE MAIN RUNWAY

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

STANDARD SPECIFICATIONS FOR MALLEABLE CASTINGS

1. These specifications cover malleable castings for railroad, motor vehicle, agricultural implement, and general machinery purposes.

I—Manufacture

2. The castings shall be produced by either the air-furnace, open-hearth, or electric-furnace process.

II—Physical Properties and Tests

3. The tension test specimens specified in section 5 shall conform to the following minimum requirements as to tensile properties:

Tensile Strength, lbs. per sq. in.	45,000
Elongation in 2 in., per cent	7.5

4. (*a*) All castings, if of sufficient size, shall have cast thereon test lugs of a size proportional to the thickness of the casting, but not exceeding ⅝ by ¾ in. in cross-section. On castings which are 24 in. or over in length, a test lug shall be cast near each end. These test lugs shall be attached to the casting at such a point that they will not interfere with the assembling of the castings, and may be broken off by the inspector.

(*b*) If the purchaser or his representative so desires, a casting may be tested to destruction. Such a casting shall show good, tough malleable iron.

5. (*a*) Tension test specimens shall be of the form and dimensions shown in Fig. 1. Specimens whose mean diameter at the smallest section is less than 19/32 in. will not be accepted for test.

(*b*) A set of three tension test specimens shall be cast from each melt, without chills, using heavy risers of sufficient height to secure sound bars. The specimens shall be suitably marked

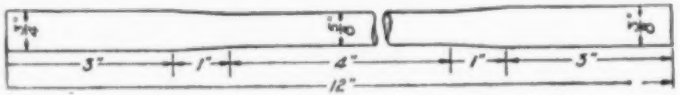


FIG. 1

for identification with the melt. Each set of specimens so cast shall be placed in some one oven containing castings to be annealed.

(*Concluded on Data Sheet No. 366*)

Adopted as standard by the American Society for Testing Materials, 1919.

STANDARD SPECIFICATIONS FOR MALLEABLE CASTINGS

(*Concluded from Data Sheet No. 365*)

6. (*a*) After annealing, three tension test specimens shall be selected by the inspector as representing the castings in the oven from which these specimens are taken.

(*b*) If the first specimen conforms to the specified requirements, or if, in the event of failure of the first specimen, the second and third specimens conform to the requirements, the castings in that oven shall be accepted, except that any castings may be rejected if its test lug shows that it has not been properly annealed. If either the second or third specimen fails to conform to the requirements, the entire contents of that oven shall be rejected.

7. Any castings rejected for insufficient annealing may be re-annealed once. The re-annealed castings shall be inspected and if the remaining test lugs, or castings broken as specimens show the castings to be thoroughly annealed, they shall be accepted; if not, they shall be finally rejected.

III—Workmanship and Finish

8. The castings shall conform substantially to the patterns or drawings furnished by the purchaser, and also to gages which may be specified in individual cases. The castings shall be made in a workmanlike manner. A variation of ⅛ in. per foot will be permitted.

9. The castings shall be free from injurious defects.

IV—Marking

10. The manufacturer's identification mark and the pattern numbers assigned by the purchaser shall be cast on all castings of sufficient size, in such positions that they will not interfere with the service of the castings.

V—Inspection and Rejection

11. (*a*) The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concerns the manufacture of the casting ordered. The manufacturer shall afford the inspector free of cost, all reasonable facilities to satisfy him that the castings are being furnished in accordance with these specifications. All tests and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

(*b*) The manufacturer shall be required to keep a record of each melt from which castings are produced, showing tensile strength and elongation of test specimens cast from such melts. These records shall be available and shown to the inspector whenever required.

12. Castings which show injurious defects subsequent to their acceptance at the manufacturer's works may be rejected, and, if rejected, shall be replaced by the manufacturer free of cost to the purchaser.

FIG. 4—SKIPS LOADED WITH PIG IRON ARE CARRIED BY THE TRAVELING CRANES AND SET ON THE HOIST BUGGIES—A TURRET CRANE SERVES TO LIFT THE SKIPS FROM THE COKE PILE TO THE HOIST AND BACK

before charging begins but most of them are loaded as needed. The charging device is similar to that used for blast furnaces. The crane sets the skip on a buggy of one of the charging machines, Fig. 4. This illustration also shows, to the right with the operator's booth attached to it, one of the two turret cranes used to lift the coal skips from the coke pile to the hoist tracks and back. The buggies are hauled to the charging floor by a steel cable wound on a tackle actuated by a hydraulic ram located directly under the inclined tracks and parallel to them. The tackle is five fold so the travel of the skip is 10 times that of the ram. Each buggy is operated by an individual lever. The lever for operating the buggy on the cupola to the right, Fig. 2 is at the left. The buggy has six wheels, the two on the middle axle have an extra broad tread, and when the car reaches the cupola the center wheels ride on a pair of tracks outside of the main tracks and are thus raised elevating the rear of the skip so that it tilts and allows its charge to slide into the cupola. This may be noted in Fig. 2 which shows the skip tilted. The joint in the buggy which enables the two wheels to ride above the other four is also illustrated. An automatic stop prevents trouble from the operator neglecting to halt the buggy at the right time. Both coke and pig iron are charged by this method, but limestone is shoveled into the cupola by the workman who operates the hoist switch

FIG. 5—PITS PROVIDED WITH STEEL RECEPTACLES FOR REFUSE AND SLAG ARE LOCATED OUTSIDE THE CUPOLA ROOM

This system of hoisting the charges to the cupola has been in service a number of years at the Allis-Chalmers

foundry and has given such service that the management decided to install it in the new shop which is now being built for making castings for the tractor that the company builds. The main advantages of the system are low up-keep costs and the small amount of labor required to operate it. Each hoist charges the cupola almost as fast as skips can be set on the charging buggy so that the only limits to charging are the rapidity with which the skips can be loaded and the charge melted to a point where more material is needed.

As is shown in the illustrations there are three cupolas served by the inclined-plane hoist. Two of these cupolas are lined to 72-inch diameter, and one to 56-inch diameter. Two other cupolas, both lined to 72-inch diameter are located on the opposite side of the foundry. They are equipped with an elevator of the usual type for carrying the charges to the platform. In the 72-inch cupolas 8000 pounds of metal are put on a charge. Usually two cupolas are operated on the same day, but when busy three cupolas are used.

Underneath the charging platform they are bricked off from the main foundry as illustrated in Fig. 3. This illustration shows one of the wall cranes and also one of the girder cranes which carry the metal to the molds. A medium size ladle may be seen in the tapping pit of the cupola in the center of the illustration.

Two pits are located in the yard immediately outside the cupola room. The one of these, Fig. 5, is round, and a steel bucket for refuse is set into it. The other, to the right Fig. 5, is oblong and holds a steel box. Slag is brought from the cupolas in a buggy and dumped into the box as illustrated. A rail is laid beside the box to prevent the buggy from being pushed over too far. These receptacles are picked up by the crane and dumped into industrial cars to be carried to the dump.

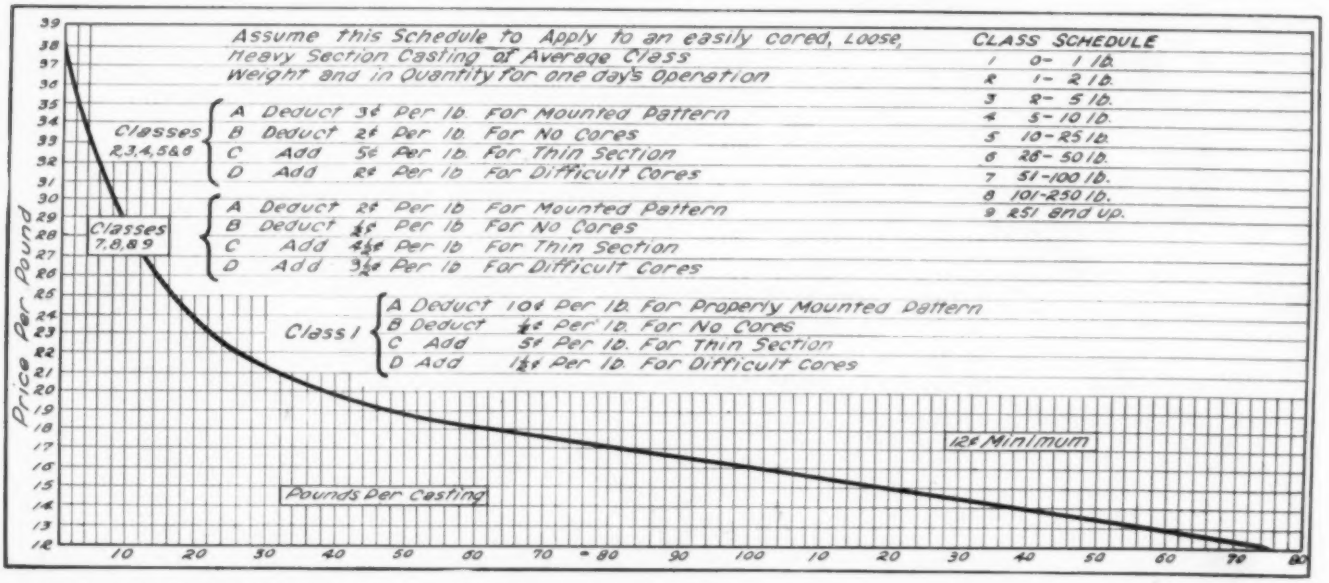
Chart Assists Salesmen in Setting Prices

TOO many foundries in the past had such poor cost systems that unknowingly they were selling certain casting below what it cost to produce them and, conversely, were charging excessive prices for others. To overcome this the American Foundrymen's association, a few years ago, actively took up the work of interesting foundrymen in a standard cost system. This system was devised and is now in booklet form for the benefit of foundrymen. It provides a means by which all foundrymen may find the cost of their castings and be assured that no castings are sold at an unfair price, either in reference to themselves or to their customers. However, it is not possible to get exact overhead expense until a foundry is operating, therefore a new shop must calculate their overhead expense and considerable of their production expense on a more or less estimated basis, in order to arrive at an adequate selling price for the product.

A new steel company, before it started operations this spring estimated its costs for making electric steel castings and then drew up a chart for the benefit of its salesmen. This chart, shown in the accompanying illustration, enables the salesman to easily determine the selling price of any casting. The curve is based upon an easily-cored, loose, heavy-section casting of average class weight and in quantity for one day's operation. Of course only a small number of castings would fall under this description, but allowances are made on the chart, for different contingencies.

As may be noted under *Class Schedule* castings are divided into nine classes. Class 1 covers all castings up to 1 pound in weight; class 2 extends to those weighing 2 pounds; class 3, to 5 pounds; class 4, to 10 pounds; class 5, to 25 pounds; class 6, to 50 pounds; class 7, to 100 pounds; class 8 to 250 pounds; and all castings above this weight are included in class 9.

These classifications serve two purposes. The one purpose is to establish divisions for adjusting prices from the standard scale. As may be noted on the chart, two causes are marked for an added charge and two permit reductions. In class 1 a deduction of 10 cents per pound is allowed for a *properly* mounted pattern, while in classes 2, 3, 4, 5 and 6 three cents per pound reduction is allowed in the price when mounted patterns are furnished. For the larger castings, classes 7, 8 and 9, a reduction of only 2 cents per pound is allowed in such a circumstance. Another occasion for a reduction is when no cores are needed. In classes 1, 7, 8 and 9 this amounts to ½ cent a pound, while in classes 2, 3, 4, 5 and 6


Assume this Schedule to Apply to an easily cored, Loose, Heavy Section Casting of Average Class Weight and in Quantity for one day's Operation
CLASS SCHEDULE
1 0- 1 lb.
2 1- 2 lb.
3 2- 5 lb.
4 5- 10 lb.
5 10- 25 lb.
6 26- 50 lb.
7 51-100 lb.
8 101-250 lb.
9 251 and up.
Classes 2,3,4,5&6
A Deduct 3¢ Per lb. For Mounted Pattern
B Deduct 2¢ Per lb. For No Cores
C Add 5¢ Per lb. For Thin Section
D Add 2¢ Per lb. For Difficult Cores
Classes 7,8,&9
A Deduct 2¢ Per lb. For Mounted Pattern
B Deduct ½¢ Per lb. For No Cores
C Add 4½¢ Per lb. For Thin Section
D Add 3½ Per lb. For Difficult Cores
Class 1
A Deduct 10¢ Per lb. For Properly Mounted Pattern
B Deduct ½¢ Per lb. For No Cores
C Add 5¢ Per lb. For Thin Section
D Add 1½¢ Per lb. For Difficult Cores
12¢ Minimum
Price Per Pound
Pounds Per Casting

A CURVE INDICATES THE BASE PRICE FOR CASTINGS OF DIFFERENT WEIGHTS—ADDITIONS AND DEDUCTIONS ARE MADE ACCORDING TO THE SCHEDULE MARKED ON THE CHART

a reduction of 2 cents a pound is made. Additional charges are made when the castings have thin sections and when difficult cores are required. An increased charge of 5 cents per pound is made for castings in classes up to and including class 6 when the sections are thin. For classes 7, 8 and 9, the increase is only 4½ cents. Difficult cores add 1½ cents per pound to the price of castings in class 1 which have difficult cores; the addition in classes 2, 3, 4, 5 and 6 is 2 cents, and in classes 7, 8 and 9, it is 3½ cents.

The second purpose served by this classification is in cost accounting. From the start of the foundry, costs of castings were kept according to order number, where possible, and from these costs information is being secured to determine the exact costs of the different classifications and grades. As any changes in the amounts to be deducted or added are found desirable they are noted on the chart. However, when a change in the cost of operation or of materials is made which affects the entire curve a notation is made on the chart, such as, "deduct 3 cents per pound beginning June 1." Should the relation of charges for the different weights be ununiform an entire new chart would have to be made. This chart is of great assistance to the salesmen as with continued accumulation of cost data it will be founded on exact calculations.

Some Points on Operating a 36-Inch Cupola

Question: We should appreciate some information on how to operate a cupola 36 inches in diameter inside the lining. Our work consists of light castings and we propose to melt from 3 to 5 tons a day. What is the correct height for the coke bed in a cupola that size, how much should such a bed weigh and what should be the relative weights of the succeeding coke and iron charges? We should also like to know the proper relative proportion of pig iron and scrap, stove plate and machinery, to use in our work and the silicon content to specify when we order pig iron. Is it necessary to flux the furnace and what and how much material is required for that purpose? Do you think it is better practice to tap the iron into a mixing ladle or to catch it directly from the spout in hand ladles? What is the proper blast pressure for a cupola of the size indicated?

Answers: Taking your questions in the order in which they are written, the following may be regarded as standard practice:

(1) The coke bed should extend about 30 inches above the top of the tuyeres. This does not mean 30 inches above at the time the coke is first thrown in to the furnace. It means 30 inches above after the coke has settled down and just before the iron is charged. The volume and weight of coke on the bed will depend on the height of the tuyeres. In the average 36-inch cupola this point is about 14 inches above the sand bed. In such cases the amount of coke required for the bed will weigh about 700 pounds.

(2) In ordinary practice from 1500 to 2000 pounds of iron and coke in the ratio of 1 to 10; or from 150 to 200 pounds is used in a cupola this size. However, since your work is extremely light, it will be advisable to use smaller charges of iron and larger coke charges.

(3) The class of castings you are making should analyze about 2.25 to 2.50 per cent silicon and since the average furnace loss is 0.20 per cent, you should charge iron having a silicon content of about 2.75 per cent. Ordinary machinery scrap will run from 2.25 to 2.50 per cent silicon and stove plate scrap will average even higher silicon content to make up for the furnace loss. Owing to the constantly changing nature of the scrap usually found in a foundry yard, it is impossible to lay down a hard and fast rule, but a fair approximation would be pig iron having a silicon content of 2.75 per cent silicon and the remainder of the charge scrap, either machinery or stove plate, or half and half of each. There is a prejudice against the use of stove plate scrap which is not justified. Clean stove plate scrap is excellent iron. Only the old and rusty parts are dangerous.

(4) If you are using a good grade of coke there is no necessity for slagging a 36-inch cupola while melting from 3 to 5 tons of iron. However, if you find the cupola choked in the morning or hard to chip out it will be necessary to draw the slag. Commencing at the third or fourth charge throw in a couple of shovelsfull of limestone on every succeeding charge. Open the slag hole after the melting has been going on for about half an hour.

(5) It is preferable to tap the iron into a mixing ladle and fill the hand ladles from it. It insures a more thorough mixing of the iron. However, in many light work foundries the iron is caught directly from the spout. The idea of course, being to secure the hottest iron.

(6) A blast pressure of 10 ounces is about right for a 36-inch cupola. Pressure after all is only incidental, volume is the main consideration. To allow for friction and other losses the blower should discharge 3000 cubic feet of air a minute.

Pipe Makers Enter Into Selling Arrangement

Announcement is made by the Somerville Iron Works, Somerville, N. J., that a selling arrangement has been perfected with the National Cast Iron Pipe Co., William B. Neal, western sales manager, 122 South Michigan avenue, Chicago, for the exclusive sale and distribution of its product in Northwest and Middle West territory. Sales in Middle West territory will be handled by A. E. Nelson, of the same company, with offices at 903 Commerce Trust Co. building, Kansas City, Mo.

To expedite deliveries the company has leased a warehouse in the central manufacturing district of Chicago. This has been equipped with mechanical loading and unloading devices to handle stock rapidly.

The Somerville Iron Works is one of the important producers of cast iron soil pipe and fittings, with plants at Somerville, N. J., and Chattanooga, Tenn., the latter being a new plant equipped with all modern devices for production and marketing.

Tractor Industry Shows Increase for 1919

Reports received by the bureau of public roads of the United States department of agriculture from 80 manufacturers of tractors show that during the year 1919 they manufactured a total of 164,590, as compared with 132,697 in 1918. The output for the year would have been much larger but for labor troubles and the shortage of material. The report also gives the number of tractors sold in the United States as 136,162, while 19,693 were sold for export. There was a decided decrease in the number of tractors sold for export in 1919 as compared with the preceding year, which was 36,351. In all, reports were received from 156 companies, but only 80 had manufactured machines during the year. It is believed that the total number of machines manufactured by those 80 firms represents at least 95 per cent of the total tractor production in the country during the year. Following is a summary of the reports received from the manufacturers covering the period:

	1916	1917	1918	1919
Made	29,620	62,742	132,697	164,590
Sold in U. S...	27,819	49,504	98,470	136,102
Exported	....	14,854	36,351	19,693
On hand Dec. 31	....	15,525	15,401	27,740

The C. & G. Cooper Co., engine builder, Mt. Vernon, Ohio, states that it has postponed indefinitely its plans for the erection of a new plant, which it had under consideration for some time and which was announced recently.

Elements in Iron Control Mixtures

Hardness of Cast Iron Mainly Determined by the State of the Carbon Which Is Controlled by Other Elements—Silicon Tends to Free Carbon and Sulphur to Hold It in Combination

BY FLETCHER COLLINS

WHEN the foundryman buys pig iron of a definite composition he does not expect to melt it without an admixture of scrap metal and produce a casting of the same composition as that of the pig iron. If this could be done, the correct solution to all the foundryman's metallurgical problems could be easily reduced to definite formulas.

The foundryman's problem is to buy grades of foundry pig iron of such composition that when mixed with a certain percentage of scrap, the percentage to be determined by him, and melted in a cupola or air furnace it will produce a metal which will be satisfactory for the casting into which it is to be formed. He must make allowance for the amounts of silicon and manganese which are burned out of the iron during melting and the gain of sulphur which is absorbed from the coke used to melt the iron.

Besides the composition of the metal, the size and shape of the casting to be produced must also be considered. After taking into account the shape of the casting to be produced and the strength of the metal desired, the first question is, what grade or grades of pig iron must be used in producing it. Should it be all No. 1X, or part No. 1X and part No. 2 plain, or part No. 2X and part No 3, or all No. 2 plain? Also, what percentage of scrap can be added? Scrap is generally cheaper than foundry iron, and by using a maximum amount of scrap and a minimum amount of pig iron, the cost of the casting can be lowered appreciably. Pig iron, without any scrap, would make entirely too rich a metal for a medium heavy casting, and in case not enough scrap is used, there will be an area near the center of the casting which will be fairly spongy, due to internal shrinkage. Thus the casting will be weaker than if a greater amount of scrap had been added to the mixture. So scrap is not only a cheapener, but is a necessity in many cases to secure the desired properties in the iron. In the production of small, thin or intricate castings less scrap need be used. On the other hand, in making such castings as sash weights on which no machining has to be done, and where there are no thin or intricate parts, the foundryman sometimes uses all scrap and no pig iron.

The quality of the cast iron depends not only on the way it is melted and the proportion of scrap to pig iron in the charge, but also on its composition. The different elements contained in the iron have a marked effect on its physical properties.

All pig iron contains carbon, which is acquired in the smelting of ore in the blast furnace. Iron ore contains little or no carbon, but as coke which supplies the heat in the blast furnace for the smelting of the ore is about 85 per cent carbon, the iron in being smelted absorbs carbon to the saturation point. The amount of carbon which it will contain is about 3.50 per cent. Carbon is the most important element in pig iron, and it is largely through the control of its action that castings can be produced almost as hard as flint or soft and machinable. Carbon appears in two distinct states. In one state the carbon is chemically combined with the iron. The percentage of combined carbon in pig iron, as in all gray-iron castings, to a large extent determines the hardness of the iron. The higher the percentage of combined carbon, the harder is the iron and therefore the more difficult to machine. An iron with low combined carbon will show a soft machinable casting, without materially affecting the strength of it. In the second state the carbon is free and appears as graphite, or graphitic carbon.

The presence of large crystals of iron on the face of a broken piece of pig iron indicates that while the pig was cooling from the molten state, where all the carbon has been combined, the majority of the carbon changed to the graphitic state. The presence of fine crystals on the broken surface of the pig indicates that in cooling from the molten state, not as large a proportion of the carbon has become graphitic and more of it remains in the combined state. The volume of carbon from the point of softness of the casting is not quite as simple as it appears here. For while the combined carbon directly hardens the iron the percentage of graphitic carbon has an indirect effect upon its hardness. For instance, in the reverberatory air furnace part of the carbon is oxidized and passes away as a gas; and while the combination of pig iron and scrap in the charge may have 3.50 per cent total carbon, the resultant casting might contain only 3 per cent total carbon. If we have two castings, one of them containing 3.50 per cent total carbon, 0.25 per cent of which is combined and 3.25 per cent graphitic, and the other one containing 3 per cent total carbon, 0.25 per cent of which is combined and 2.75 per cent graphitic, although both contain the same percentage of combined carbon, yet the second one with the lesser percentage of graphitic carbon will be considerably harder than the first one with the larger percentage of graphitic carbon. So our original statement that the hardness depends upon the percentage of combined carbon is thus modified, and the percentage of graphitic carbon appears to have a definite effect upon hardness. This effect of the graphitic carbon is difficult to explain to a layman.

Briefly, the hardness of the iron with the lower graphitic carbon, other conditions being similar, is caused by changes in the microscopic crystaline structure of the metal. Combined carbon occurs as pearlite, martensite, cementite, and in a few other forms and lowering the graphitic carbon contents will influence the forms which the combined carbon assumes. So we should have said in the first place that it is the percentage *and the state* of combined carbon which determines its hardness to a large extent. But this explanation goes farther into metallurgy and crystallography than is within the scope in this short paper. Graphite also acts as a lubricant and enables a machine tool to cut the iron without becoming overheated.

The question then is, why do not combined and graphitic carbon always stay in the same relation. This is the crux of the matter. It is the action of the various other elements in the iron and other agencies in changing or helping to change the carbon from the combined state to the graphitic state, or conversely, in retarding this change while the molten iron is becoming solid. This is the main problem in producing castings

of a desired hardness. This indirect action then will throw into our discussion the effect of the other elements in cast iron. The direct influence of the elements other than carbon on the iron is usually only of secondary importance. It is their action on the carbon which is of primary importance. So we will take the impurities separately, and examine their total values and various actions in the order of their importance.

Next to carbon, silicon is the most important element in cast iron. The presence of silicon in larger percentages helps in expelling the combined carbon from the crystal of iron in the pig as well as in the casting. This expelled carbon becomes graphite, or graphitic carbon, and is deposited on the outside of the walls of the crystals of iron. This expulsion allows the individual crystal to become quite large. Crystals in open pig iron, as it is called, are often quite as large as an eighth of an inch across. The graphite surrounds these cubical crystals like small square plates, and it is possible to brush a newly broken piece of open pig iron with a whisk broom and see several tiny square plates of graphite float to the ground. The effect of this expulsion of combined carbon is to soften the iron.

How Silicon Acts

Generally the higher the silicon content of the pig iron, the more open is the grain and the more graphitic carbon and consequently the less combined carbon it contains. Therefore, a high percentage of silicon in the pig iron allows the use of a greater percentage of scrap in the mixture. Often foundrymen who have to produce thin machinable castings and find their pig iron at hand is too low in silicon use what is called 8 per cent high silicon, or silvery iron, as a medicine. But it would not do to get the silicon in the casting too high, as silicon has a direct action upon iron of hardening it, or doing the opposite of its indirect action. It also would not do to use 10 to 15 per cent of silvery iron and the remainder scrap. It would thus be possible to secure a casting of the desired silicon content, but the higher sulphur content of the scrap would for many kinds of castings more than overcome any advantage that would be gained in cost. So for all average gray iron castings in which even a fair amount of strength is required, pig iron, or rather one or more of the grades of foundry pig iron, must be used and considered the base, and it is to be used in larger or smaller proportions intelligently by the foundryman, according to the nature of his proposed castings.

Some castings such as steam cylinders are required to be close grained, that is, with very small crystals. If they are open grained, steam will be apt to leak through them, consequently a low-silicon pig iron must be used along with sufficient scrap to make them closer grained. But if too much scrap is used it will weaken the metal on account of its higher sulphur content. The silicon in the pig iron must be high enough and the percentage of scrap must be so regulated that the castings will not be so hard that they will not machine readily, as the whole inside of a cylinder must be carefully finished. Other castings must be hard, such as car wheels and some rolls. Unless the surface, or tread of a car wheel is hard it will have excessive wear. To secure the desired hardness the metal must contain a low amount of silicon. Since the changes of carbon from the combined state to the graphitic state takes a minute or so, a cold plate of iron, called a chill, is brought in contact with the tread of the wheel, to cool the iron quickly. This sets the iron at the tread, and for perhaps an inch below the tread, into a solid state before the carbon has had time to separate out as graphite. A hard white shell with practically no graphitic carbon and infinitesimal crystals is thus formed. The tread fracture looks somewhat like high-carbon steel. As the center of the wheel must be machined so that the axle will fit into it snugly, and as a car wheel which is too hard would be dangerous because of its brittleness, the iron must have enough silicon, and thus be soft enough to machine and to retain its toughness.

The reason a thin casting requires a high silicon content and a comparatively small amount of scrap, is that it cools so quickly that unless the change in carbon is materially aided and hastened by a fairly high silicon content, the casting will become rigid before the carbon has had a chance to separate out as graphite. This will cause the casting to be brittle and unmachinable.

Sulphur is of importance because of the harm it does in many castings. It has the opposite effect of silicon as far as carbon is concerned. The higher the sulphur in the iron the more combined carbon and less graphitic carbon will be present. Sulphur also has a direct hardening effect and makes the iron sluggish so that it will not take on a sharp form in the mold. High sulphur in a casting makes it brittle, weak, hard and treacherous. It also causes blow holes as well as uneven shrinkage which produces internal strain. Sulphur is absorbed by the iron from the fuel and cast-iron scrap has twice to ten times higher percentage of sulphur than good standard foundry pig iron. So the average foundryman starts out with a low and definite sulphur content in his pig iron and a higher amount in his scrap iron. Then in the melt, more sulphur is absorbed from the coke. When it is realized that the sulphur in the best foundry coke is not much under 1 per cent the foundryman's fight against sulphur can be appreciated to some extent.

Phosphorus is an interesting component of cast iron. The good effect to be looked for in an iron containing the proper percentage of phosphorus is fluidity. Such iron is originally more fluid, and it keeps its fluidity for a longer time after having been poured into the mold than an iron containing less phosphorus. This produces sharp outlines in the casting. But with phosphorus much higher than 1 per cent the iron is weakened. Phosphorus does not leave the iron during the melt, that is, all the phosphorus of the pig iron and scrap is inherited by the casting and practically none is gained from the fuel.

Manganese a Deoxidizer

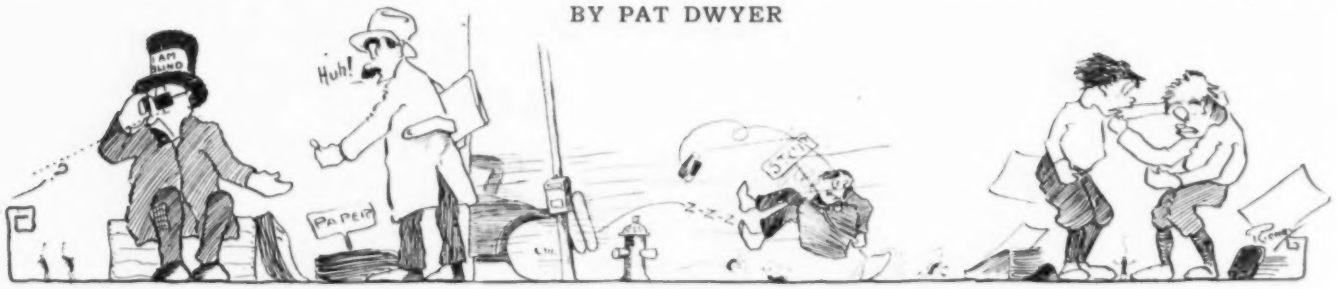
Manganese also plays a role in controlling the properties of cast iron. It is a valuable component in that it has an affinity for sulphur and oxygen. It even seizes the oxygen from iron oxide, or burned iron and forms manganese oxide. The iron is thus released and the manganese oxide floats to the top of the melt and does not show up in the body of the casting. It also retards the action of the sulphur of the coke in entering the bath of metal. So manganese is known as the great physic of the cupola. It has the effect, if much over 1 per cent, of holding the carbon in the combined state and thus closing the grain and making the iron hard. Since, except when abnormally high, it does not segregate much, or cause unequal strains, brittleness or weakness, it does not impair the ultimate strength of the metal. In good cylinder practice a foundryman can use iron with manganese up to 1.50 or 1.75 per cent in his pig iron. About a fourth of the manganese of the pig iron and scrap is lost in the melt, depending upon how much combined with sulphur and oxides.

The amounts of the various elements entering the pig iron can be closely regulated by the charge put into, and the method of operating, the blast furnace. Sulphur can be controlled if the blast furnace is running properly, and nearly eliminated from the pig iron. Sulphur is required to be 0.05 per cent or less in pig iron. Silicon is under nearly abso-

(*Concluded on page* 81)

Bill Comments on Western Foundry Practice

BY PAT DWYER

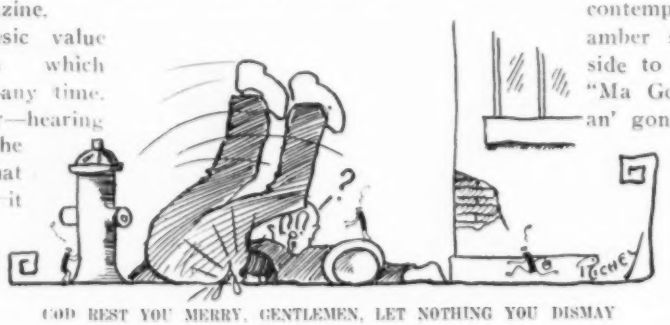


DID you ever notice the manner in which certain standard stories appear to go the rounds and bob up serenely in the most unexpected places? You probably saw one of them first in the "Wit and Wisdom" column of the old home paper. Then it appeared as a full page spread in the comic colored Sunday supplement of one of the great metropolitan dailies. Next you find it cunningly sandwiched in a monologue delivered by a two-a-day artist on one of the vaudeville stages, and finally you discover it some fine day used as a filler near the bottom of a page in some magazine.

There is a certain intrinsic value in these old veterans which makes them appropriate at any time. If a comparison is in order—hearing no expression of opinion to the contrary we shall assume that a comparison is in order—it may be said without fear of contradiction that they are in the same class as that sterling old slogan, "You can't keep a good man down." In this connection, it is only fair to point out that the foregoing is a genuine first and original slogan. It antedates by many years a modern version to the effect that a man may be down but he is never out. To our mind, the latter version lacks the piquancy, the punch and pep of the former. However, that is neither here nor there and being strictly a man of peace we refuse to be drawn into a controversy and utterly refuse to accept any correspondence on the subject.

The particular little story responsible for the foregoing train of thought appeared in a recent issue of a weekly paper published in the East and retailed for the modest sum of 5 cents the copy. I generally buy mine from a blind vendor on a street corner because I have a tender conscience and uneasy suspicion that a nickel does not even pay for the ink with which it is printed. In those dear old days, now also beyond recall, the paper shared with the tall Milwaukee laden schooners, the proud distinction of being the biggest five cents' worth in the world. Now since those lofty vessels sail no more across the bar, it bears the distinction alone. *Sic transit gloria mundi,* which translated into the vernacular means, what's the use of worrying?

I procured a copy of this Saturday paper last Thursday as usual and having arrived at home and partaken of the frugal evening meal, I proceeded to make myself comfortable and leisurely browsed through the



GOD REST YOU MERRY, GENTLEMEN, LET NOTHING YOU DISMAY

pages. It was while thus engaged in this greatest of indoor sports that I one more found the story of the colored gentleman who so neatly summarized, in one trenchant phrase, the festival of Christmas. For weeks this dusky one had denied himself many things and with a zeal worthy of a better cause had diligently saved up many stray nickels and dimes. Upon carefully counting all his available financial assets the night before Christmas, he found that he had enough to buy one quart. In view of the unsettled condition of the market at the present time and a certain natural modesty and reluctance on the part of the vendors in discussing the business openly, it is rather difficult to offer even an approximate quotation. However, for all practical purposes, it is sufficient to say that he had the price of a quart. What is more to the point, it is apparent from the evidence submitted he procured the quart and having slipped it neatly into one of his Kentucky quart pockets situated on the southeast corner of his person, he started for home. Stepping along lightly and cheerfully at peace with himself and all the world and whistling a merry Christmas carol meanwhile, he did not observe a patch of smooth ice which lay directly in his path. His feet flew from under him and he sat down heavily, suddenly and with crushing and disastrous force on the precious quart. He did not say what you would say and what in all fairness you would be justified in saying. He slowly arose and while contemplating the priceless, spreading amber stain he shook his head from side to side and remarked mournfully "Ma Goodness! Christmas done come an' gone already!"

The magazine lay open in my lap and my mind went back over the many Christmas days I had known. It came to rest at last as it usually does upon a certain Christmas day when I had stood above an open little grave in the quiet corner of a cemetery that was covered over with white and drifted snow. It was a bitter experience and although I forget at times, the details come back with painful vividness on each recurring thought of Christmas day.

On this night I was feeling decidedly blue, when Bill came in and afforded a welcome distraction. As I have intimated elsewhere in these memoirs Bill is one of those free and easy persons who says exactly what he thinks at all times and under any and all circumstances. Consequently I was not surprised when he said to me:

"If I had a face like you are wearing, as long as a French fiddle, I should apply for a job in a movie studio. I would write a 5-reel scenario based on Cervantes' masterpiece and then get a part playing the character of Don Quixote. As the Knight of The Sorrowful Countenance you would be a knockout. Between author's

rights and box office receipts, you should clean up enough filthy lucre to last you for the rest of your natural life. In fact there should be enough left over to warrant a few learned limbs of the law in staging a modest scrap over its final disposition."

In deference to our long acquaintance and knowing that his heart is in the right place, I did not like to tell him that his levity was ill timed. Instead I suggested that he was overlooking an easy and obvious way of making a fortune for himself.

"Ha!" said he, "Friend of me buzzum, your line of talk hath a pleasing financial ring to it . Pray consider that I have pricked up my ears and am now hanging, mouth agape on your lightest whisper . Proceed."

"Well," I said. "What's the matter with relating the history of your life to one of those professional scenarioists. He easily could whip it into shape for the screen, tack on a snappy title like:—'the Hobo Molder's Revenge, or Who Threw the Pig in the Furnace' and there you are."

"'Tis true I have had some interesting experiences during the course of a fairly long and I trust not a wholly misspent life," said Bill, "but nothing to compare with the adventures of some of the hobo molders I have had the pleasure of meeting from time to time. Candor compels me to admit that Baron Munchausen showed rare judgment when he carefully avoided selecting a foundry as the scene of any of his exploits.

"I was doubled up with one of these birds in the Mesta in Homestead, Pa., at one time and the days certainly passed swiftly while listening to his entertaining line of chatter. He came originally from North Adams, Mass., and to my certain knowledge had never been west of Chicago; but the scene of his adventures invariably was laid in *The West*, a portion of our fair land which he vaguely referred to as *The Coast*. To hear him tell it, the *Coast* was a fearful and wonderful land and he certainly evinced a fair measure of cleverness in adapting foundry conditions to suit a country known to him only through the writings of Col. Prentiss Ingraham in that classic series of tales known as "Beadle's Boy's Library."

In a general way I gathered that a pair of long barreled .44 caliber revolvers were considered the most important tools in a man's kit and easy and promiscuous shooting an every day occurence. Personally he had shot several men for infractions of shop etiquette which merited nothing more drastic in the East than a bawling-out. Lifting another man's gaggers when he was not looking, hiding, the dry brush or bellows, pinching facing or parting sand, neglecting to return borrowed tools, catching in at the spout out of his proper turn, refusal or tardiness in giving a lift when called upon, were a few of the items he enumerated as offering sufficient provocation to merit a sudden and violent death.

THE LIONS DEVELOPED A TASTE FOR LITTLE FAT APPRENTICES

"Putting up the day's work was attended by hazard to life and limb from prowling of bands of wild Indians and wilder beasts of the jungle. It was considered nothing uncommon to see a mountain lion stalk into the shop, take a drink out of a swab pot and then grab a fat little apprentice out of the dog-house and bound away to his native lair in the mountains.

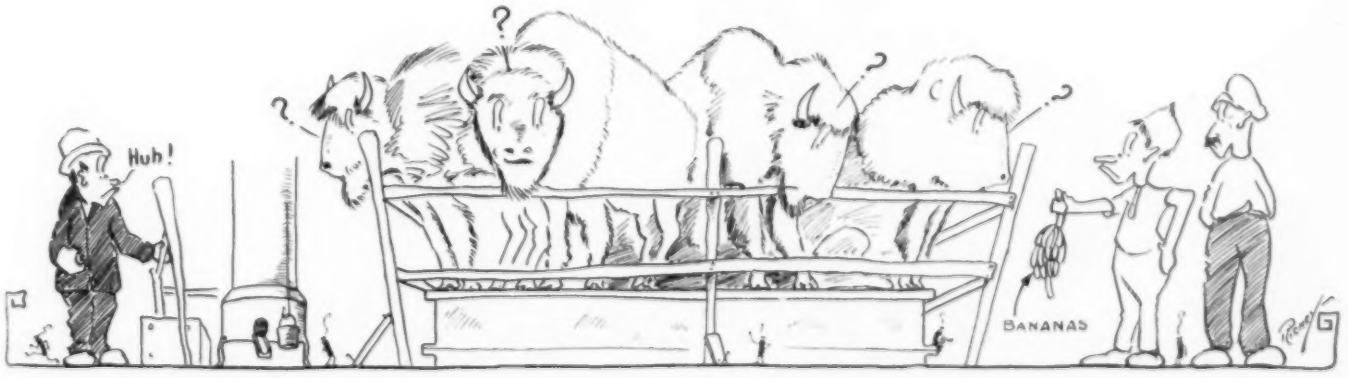
"Our hero had the good fortune on several occasions to come to the rescue by planting a well aimed bullet immediately behind the animal's left front shoulder blade as he sprang through the open doorway.

"As for Indians, he assured me solemnly that on *The Coast* no one ever thought of buying a ball of shoemaker's thread, or of teasing out a piece of hemp rope to make a swab, no indeed. Whenever a man needed a new swab, he simply went out and shot a wild Indian and scalped him. It appears that the top-knots affected by these wandering marauders make the finest kind of swabs—you know one of those things that once used you'll use no other. For blacking the teeth of a gear wheel or other delicate jobs of that character, he had never seen anything to equal them.

"The foundrymen on the *Coast* are resourceful and since as everyone knows, lumber is plentiful in that country, they adapt it to many uses never considered or even thought of in the effete East."

"If you will kindly pardon me for interrupting you for a moment Bill," I said "I should like to know what is the idea in using the word 'effete.' Am I to understand that it was employed by this rude and rough person whose veracity, to say the least is extremely questionable, or am I to infer that you played it directly off your own bat as they say over 'ome?"

"Since you are so nosey," said Bill, "I don't mind telling you that I used the word with the express intention of seeing whether you would notice it or not. Quoting him verbatim he had said: 'Say kid lemme tell ya something these birds on the coast use lumber around a foundry in a way that would give some of these here ginks in the East heart failure'."



IN THIS TYPICAL WESTERN FOUNDRY SCENE THE ARTIST HAS NOT CONSIDERED IT NECESSARY TO SHOW THE THROWING DEVICE

"He had observed an interesting example of this kind in a shop which had received an order for several building columns 20 feet long by 12 inches in diameter. Instead of making an expensive pattern and corebox, the patternmaker had gone into the woods and cut down a tree of the required diameter. This was sawed off to the proper length allowing 6 inches at each end for core prints. This was to serve as a pattern. A second tree, about 7 inches in diameter and the same length, was fitted-up as a core barrel by driving several rows of 3-inch nails into it and allowing them to protrude about 1½ inches. The mold was made in the usual way and then a thickness of sand was swept on the core barrel.

"When the novel core barrel was entirely finished,it was set in the mold and the cope closed down. A long plank provided with suitable openings for the runners was placed on the cope and then four tame buffalo bulls were led in and marched up on top of the plank to serve as weights. Don't you think that was a pretty ingenious arrangement?"

"Whatever lingering doubts I may have had," I said, "touching on the authenticity of some of the statements made by that wild west rover with whom you associated in Pittsburgh have now been happily set at rest. The character of the weights employed to hold down the copes explains many things which might seem strange."

How to Weld Cast Iron Electrically

DESCRIBING cast iron welding *Electric Arc Welding*, published by the Lincoln Electric Co., says: The difficulty in welding cast iron with the electric arc is not encountered because the metal cannot be properly fused, but is due to the fact that the sudden intense heat of the arc over a local area results in the production of a hard weld and the introduction of contraction stresses which often result in cracking. Using the carbon welding process, cast iron welding rods may be fused into a cast iron piece. Using the metal electrode process and a soft iron or steel electrode, it is impossible to make a reliable weld between the added material and the cast iron. Using the metal electrode process certain work can be done by the introduction of steel studs in the cast iron pieces to be welded together so that a certain amount of strength is obtained by the bond formed between the steel studs by the welded material. For welding the small gray-iron casting shown in the accompanying illustration a $\frac{3}{16}$-inch cast-iron welding rod and 300 amperes welding capacity are required. A small gray iron casting should be broken and the edges beveled, using the carbon arc for cutting. The pieces should then be placed in a carbon mold so that the molten iron when it is added will not run away from the joint. This is shown in the accompanying figure. The carbon arc should be used to preheat the casting. It is not necessary to heat the pieces to a red heat. The carbon arc and cast-iron welding rod should then be used to fuse the added material to the piece. Care should be exercised not to play the arc upon the weld any longer than is necessary to give complete fusion. In case the metal gets too hot and runs badly the arc must be broken and an interval of time allowed for it to cool slightly to eliminate the trouble. After the weld is completed the piece should be wrapped securely in asbestos paper and allowed to cool slowly for 6 or 8 hours (larger pieces require as long as 24 hours to cool.)

Other Means Employed

As an alternative to wrapping in asbestos paper, the piece may be covered in previously heated slacked lime. The idea of the lime is the same as the asbestos, to cool the casting slowly. If the work is properly pre-heated and welded rapidly and slowly cooled the material in the weld will be as readily machineable as the balance of the piece. No flux of any kind is required, although borax may be used.

CAST IRON FROM A WELDING ROD IS FUSED INTO THE CASTING WITH AN ELECTRIC ARC

Oxidation Causes Trouble in Iron Castings

Question—We have been having considerable trouble with dirty iron. The castings also have small round holes near the surface. Our iron is the following composition: Silicon 2.35 per cent; sulphur, 0.09 per cent; phosphorus, 0.95 per cent, and manganese, 0.30 per cent.

Answer—There seems to be no trouble with your mixture, except in the amount of manganese, which is a little low. This could be increased by purchasing a pig iron with higher manganese, or by adding 5 to 6 pounds pea-sized 80 per cent ferromanganese to the ladle before the iron is tapped into it. The trouble probably is caused by oxidation. This may be due to having too low a bed in your cupola or not putting enough coke between the charges. It might also be due to too large a volume of air at high pressure. Oxidation of this nature would lower the amount of manganese in the iron as more than the normal amount of manganese would be burned out during the melting. We would recommend that you take precautions to see that the coke bed is at least 30 inches above the tuyeres before the metal is charged. Also put not less than 1 part of coke to 8 parts of metal on charge until you ascertain what causes the trouble. Oxidation may also be caused by steam from a mold made of sand which is too damp. Therefore, care should be taken to see that the sand is tempered exactly right.

Core Making Practice in Britain

Cores Employed to Form the Exterior as Well as the Interior of Castings Are Recognized as an Economical Factor in Reducing the Cost of Molding

IN a paper illustrated by lantern slides and diagrams read before the Coventry Branch of the Institution of British Foundrymen on Oct. 27, the author, S. Corden, said that core making had made rapid strides in the production of intricate castings and in helping to overcome molders' difficulties connected with the making of draw-backs. Few patterns are made now requiring the use of draw-back. Parts formerly made in that manner, now are provided with a core print and a core box made to suit. A method which relieves the molder of considerable trouble and insures a better job. In some instances castings are made entirely in cores with the exception of a print on the bottom and a loam plate on the top. Notable instances of this character are castings, weighing up to 10 or 15 tons used in connection with turbine work. The molding of patterns with deep or difficult copies is simplified by making cores directly off the pattern and attaching them to the cope. It makes the job easier and removes the risk of scabbing, which often happens when it is made in green sand.

Discussing sand mixtures and methods of blacking, the author spoke especially of glutrine, binderite and core gum. He claimed that when using glutrine and water with unground sand they had to contend with scabs and cracked cores. Some of the cores cracked from ¼ to ½ inch down the center. It was necessary to use the sand quite wet to secure a hard surface. It was fairly satisfactory for light castings; but invariably caused trouble in castings that weighed a hundred pounds or more. From 20 to 30 per cent scabbed cores, resulted from using binderite in trench bomb and cylinder lining cores. The sand mixture was made up of 6 parts of burnt sand; 2 parts of red sand with a little sharp sand.

Heavy Core Mixtures

For all classes of work up to 700 pounds, he recommended a core sand mixture made up of 4 parts black sand; 1 part red sand and 1½ parts manure, not dried. This mixture should be ground until the sand becomes tough and will not break if thrown up in the air in the shape of a ball, and then caught in the hand. He had used this mixture for a long time and claimed that it could not be beaten for low cost and satisfactory results. This sand could be used for making cores under the most difficult circumstances. Cores could be produced from coreboxes drafted the wrong way, or even from rough castings, because no matter how much the corebox was rapped, the core would hold its shape.

For castings over 700 pounds in weight, he favored a core sand mixture made up of 3 parts black sand; 1 part red sand and 1½ parts manure. In cases where it is necessary to bring the air off the core quickly, he recommended 2 parts of black sand; 1 part red sand and 1½ manure. He used 10 parts of blacking to 1 part of core gum for all cores over 10 pounds in weight. Under 10 pounds no binder is required in the blacking.

It is a mistake to ram the cores too hard; but it is necessary to provide sand that is tough to withstand the heat of the metal. On account of the tendency of the metal to cling to the

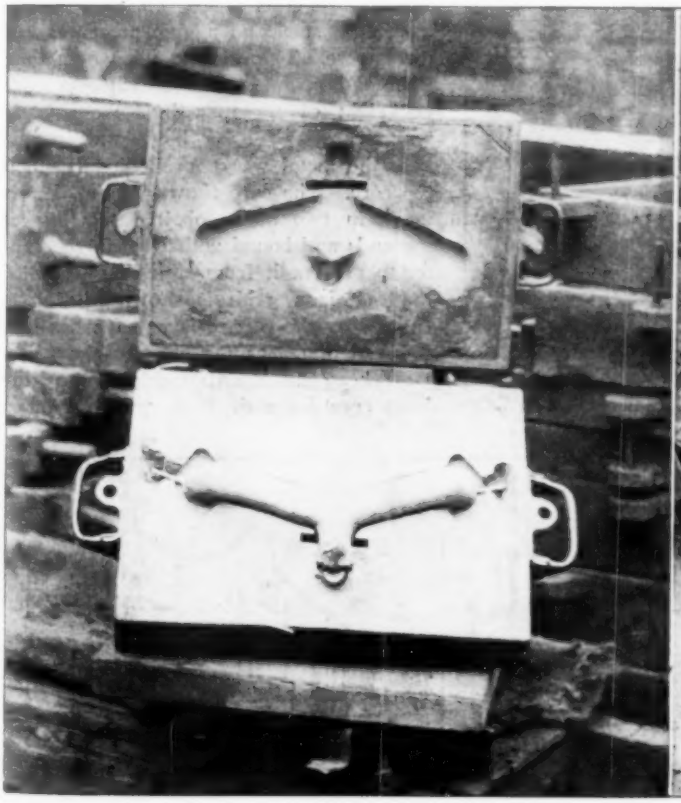


FIG. 1—MOLD AND CORE MADE FROM AN OLD CASTING SAWED IN TWO

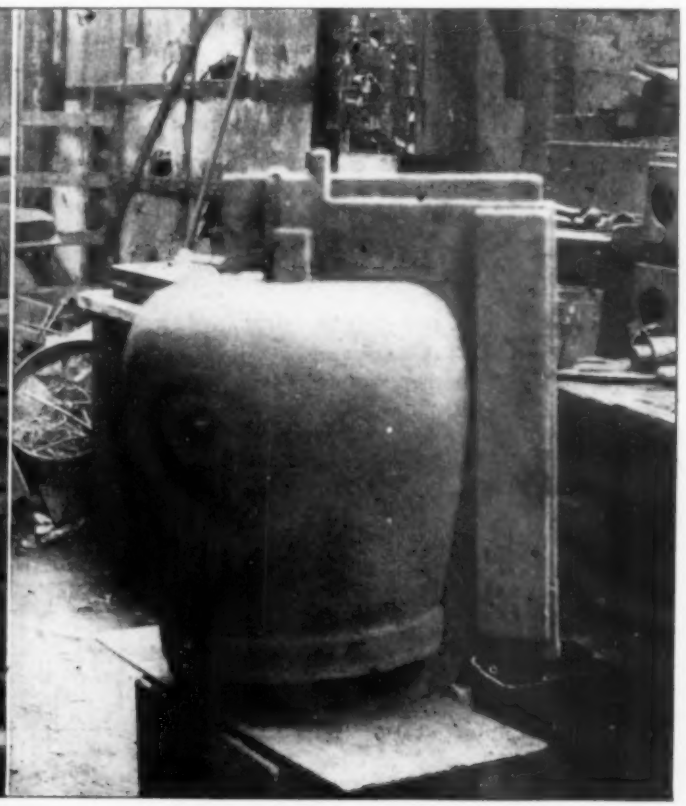


FIG. 2—IMPROVISED METHOD FOR SWEEPING A LOAM CORE

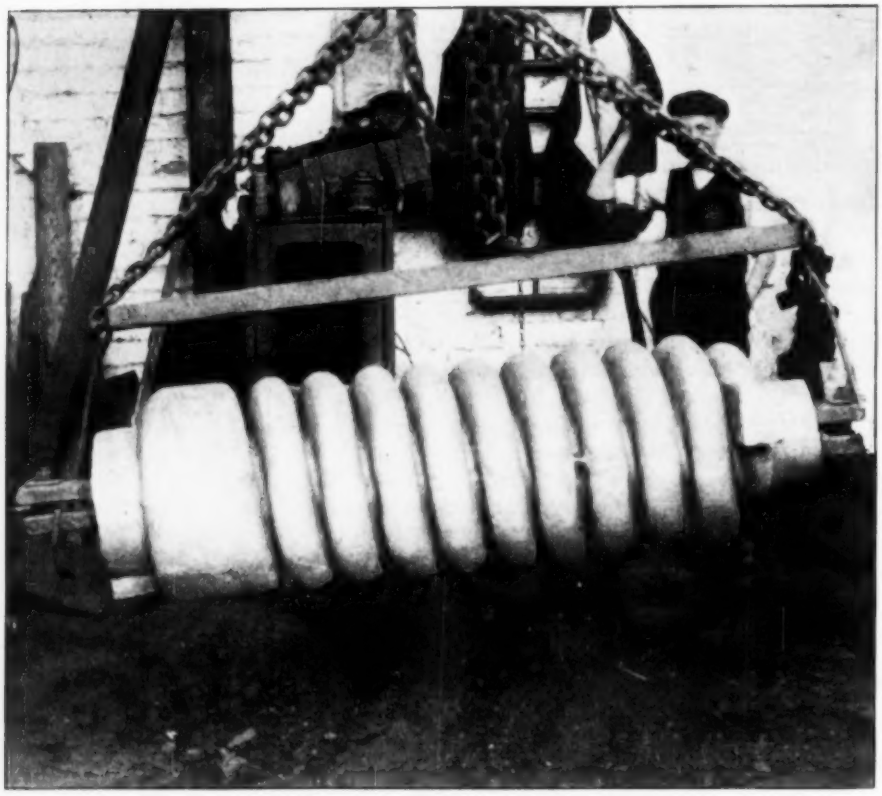


FIG. 3—CORE FOR LARGE SPIRAL DRUM USED FOR ANNEALING BEARING BALLS

core, the sand entering into the composition of the latter should be of a more substantial character than that in the former. If he had to use molder's facing, he preferred to make green sand cores. A core becomes weak and is very liable to scab when the metal runs over it. The reason comparatively weak sand is used so extensively is because it is easy to clean a core of that kind out of a casting. One disadvantage of the mixture he had recommended was that it was a little difficult to clean it out of the castings. However that did not offset its other good points.

When making bolt head or tee cores for machine tables and similar castings, he usually added a little gum to the sand in addition to the gum in the blacking. No vents were required to bring off the air in those cores.

He claimed that venting was overdone in a great many cases. If too many holes were put in, the core was weakened and there also was the risk of hitting the wire and loosening it, a condition which rendered the core useless.

Trouble With Pipe Cores.

Trouble sometimes is caused where pipe cores are made in halves and jointed. In an effort to obviate this trouble, some molders have a habit of rubbing the top off the core. This treatment removes the dense, hard crust and prevents the pipe from *blowing*. However, it is not necessary if the core is made properly. A hard skin on the top of the core is caused by the core maker ramming a layer of sand before placing the grid and then ramming around the grid.

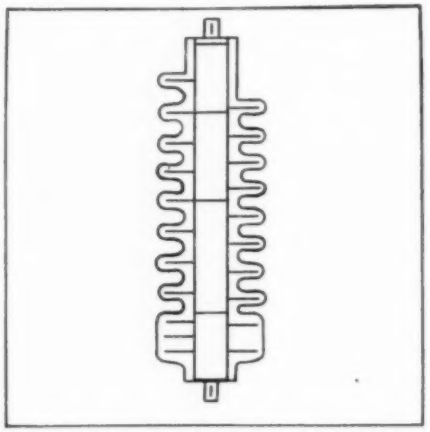


FIG. 4—CAST IRON GRID FOR ANNEALING DRUM CORE

Such treatment, on account of the sweep of the box is bound to make a hard streak along the top of the core. He had known of instances in which a second ramming was put in the box before any measures were taken to vent it. The best method is to put a little sand in the box, tuck with the fingers, set the grid and ram around it lightly, then clear a space for coke or ashes and finish ramming to the top of the box. Cores made in that way will not *blow*.

As an illustration of how easily the air came off the tough sand, he described the making of a cylindrical core about 14 inches in diameter, 3 inches thick. This core was completely covered with iron, with the exception of four 1-inch prints 2½ inches long by which it was suspended from the cope. All the gas had to come through the four prints. Two castings were made without the least sign of a *blow*.

In making the core, he set a piece of ⅝ inch tube 3½ inches long in each of the four prints. The tubes were rammed in the prints with strong gum sand. A heavy wire ring bent to a diameter that would bring it immediately over the tubes, was then set in the box and small wire hooks embracing the ring were dropped down through the tubes. A piece of wax was placed over the ends of the tubes to prevent the ashes which filled the center of the core from falling in. This core is shown in Fig. 9.

Core For Heavy Casting

The spiral core shown in Fig. 3, is for a semi-steel barrel casting weighing 15 tons used for annealing ball bearings. The charge was made up of hematite iron, mild steel and a high percentage of manganese. There is nothing worse than steel and maganese for scabbing a core yet eight of these castings were made without a scab or a blow and in one case the metal was poured directly upon the core. The core shown in Fig. 3 was made in two halves, bolted together at the ends and bound with wire in the center to prevent it from springing. One of the cast iron grids is shown in Fig. 4. In making the core, a layer of ashes was rammed in the center between the grids.

A cheap and simple tackle for making loam core for a drum swept up in loam.

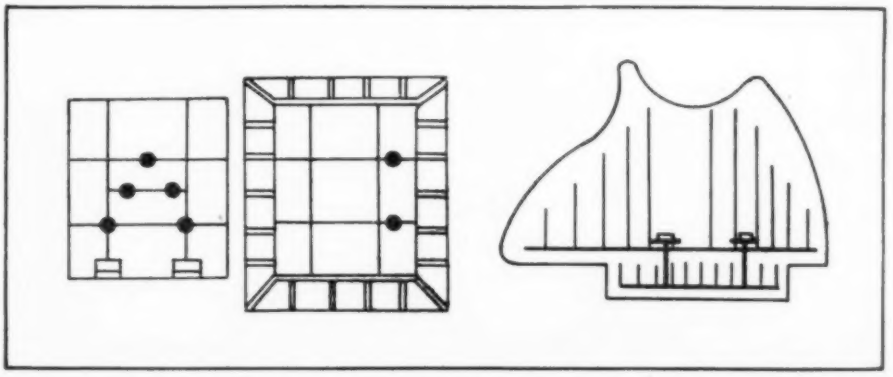


FIG. 5—GRIDS FOR HEADSTOCK FIG. 6—METHOD OF BOLTING ONE GRID TO ANOTHER

is shown in Fig. 2. In the absence of a spindle and spindle seat, they had fastened and erected a piece of wood 27 inches long to a round board cut to the size of the bottom print on the mold. The board was reinforced with two battens to prevent it from warping and the top of the upright piece of wood was turned to a diameter of 2 inches to serve as a spindle. The sweep arm and board was fastened to a short section of a 2-inch corebox and the corebox in turn was slipped over the top of the temporary spindle. A cast iron grid with upright wrought iron rods cast in was employed as a frame on which to build the core. The rods were bound with a wire near the top to prevent them from sagging. The wall of the core was built up with loam cake, and the center filled with ashes. A coating of loam was swept on to the outside after which it was placed in the oven and dried.

The author next referred to jobs that were difficult to make, owing either to poor design or faulty pattern making. He described one in particular, which required considerable manipulation on the part of the core-maker. Three large cores were provided for making this casting; but as they were originally made, it was impossible to use them. The patternmaker had only allowed 1½ inch core print on the back core, which, of course, was not sufficient to support the weight, and the casting was of such a character that chaplets could not be used. By casting two bolts in one grid in such a position that they would come through two holes in the second grid, and by cutting out the inside of the back core, it was possible to bolt the two cores together, fill the opening with ashes and stop the back with sand. The third corebox was so constructed that he had to ram one half of the core first and make a joint, and then ram the other half. The two half cores were then lifted out, one half one way, and the other half the other way and joined together.

In his opinion it was seldom necessary to use old sand for making the cores in a general jobbing shop. He had used ordinary core sand 4 black to 1 red for making hundreds of pistons, many of them poured directly on the core, and none of them scabbed.

The mold and core shown in Fig. 1 were made off an aluminum casting, which he had sawed in two longitudinally, along what normally would be the parting line on a pattern. He imbedded the top half of the pattern in a false cope, set on the other half then rammed the drag and rolled the two parts over. The false cope was then shaken out and a parting made around the drag half of the pattern. This parting included a print cut out at the end of the middle branch. He bent a wire to fit the inside of the pipe and project through the three openings after which the inside was filled with core sand, and the top half of the pattern rapped down into place. The cope was then rammed and lifted off.

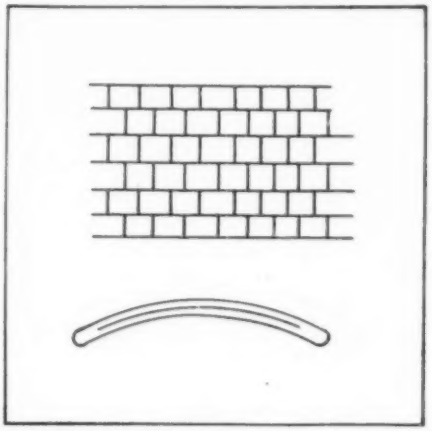


FIG. 8—FOR CURVED FLAT SHAPES A GRID MADE UP OF A NUMBER OF WROUGHT-IRON STRIPS IS THE MOST CONVENIENT

The top half of the pattern was then taken off, and the pattern lifted out and placed in the oven to dry. When the drag half of the pattern had been taken out and the mold finished, the core was replaced and the mold closed. The wires projecting from the core at the three prints served to hold the core in its place without resorting to chaplets. Many castings could be made in that way, and if only one or two castings were needed, the process was much cheaper than making a pattern and corebox.

A Make Shift Job

He had used another method in making a bend pipe with a bracket cast on for a sand blast plant. The old casting was fitted up for a pattern with a couple of pistons for core prints, after which it was rammed up in the ordinary way, taken apart, finished and placed in the oven to dry. After the mold was dried, it was set on the floor and a thickness of loam corresponding to the thickness of metal in the casting, was swept on the inside face of each half. When this had dried, a core arbor was set in and the two half cores rammed up, the half molds taking the place of coreboxes. The half cores were lifted out, dried, and joined together and after the thickness of loam had been cleaned out of the mold, the core was set in and the mold closed. Two castings had been made in this manner quite successfully.

Various styles of grids were shown, including that shown in Fig. 7, designed to be used in sweeping a barrel core larger at one end than the other. The set of grids shown in Fig. 5 had been made for a headstock casting. For making comparatively thin curved cores, he had found that the most convenient grid was made of a number of pieces of wrought iron lashed together and bent to the shape of the box. An example is shown in Fig. 8.

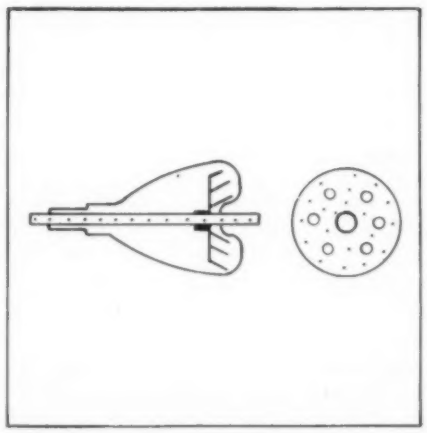


FIG. 7—ARBOR AND GRID FOR MAKING BARREL CORE WHEN ONE END IS LARGER THAN THE OTHER

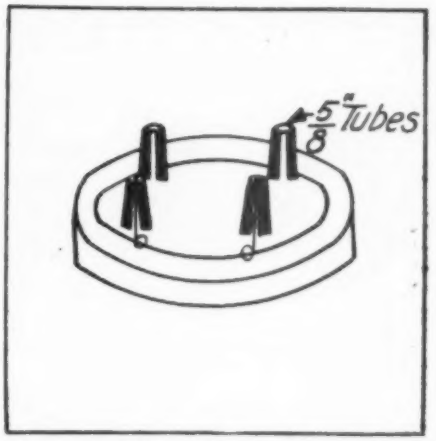


FIG. 9—METHOD ADOPTED FOR ATTACHING TUBES HOOKS AND LIFTING RING IN A CYLINDRICAL CORE ALMOST ENTIRELY SURROUNDED BY IRON

Connellsville Foundries Effect Merger

Announcement is made of the merger of the Munson Heater Co. and the McCairns Foundry Co., of Connellsville, Pa., into the Munson-McCairns Heater & Foundry Co. The consolidation was brought about to enable the heater concern to increase its output to about 3000 furnaces annually and also to provide for expansion of the foundry business. The merger means the employment of additional men. The Munson Heater Co. has been obtaining its castings at Cleveland, O. With the consolidation, the foundry part of the plant will furnish the light and heavy castings needed. The Munson Heater Co. was organized in Connellsville in 1904 by George A. and J. C. Munson. James McCairns, of the McCairns Foundry Co., is a veteran in the foundry business and has been in business in Connellsville for a number of years.

Heat Modifies Acid Furnace Reaction

Electric Furnace Develops Such High Temperatures That Chemical Affinities Are Reversed—Steep Sides with a Deep Bath Increase Melting Efficiency—Compact Charge Is Advocated

BY JAMES W. GALVIN AND CHARLES N. RING

IN the manufacture of steel one of the most difficult problems to be dealt with is the oxidation of the metal that takes place during the process of melting down and refining. Regardless of what process is used, this matter of oxidation must be taken into consideration and even in the crucible process oxidation cannot be entirely eliminated, as there is always a certain amount of oxygen present in the charge in the form of rust or oxide of iron and also in the atmosphere contained within the pots. In fact, it is very doubtful if there is a possibility of making steel, by any process, in which a certain amount of oxidation of the metal does not take place.

The birth of the electric steel furnace is due to the desire to produce a steel by a process wherein this oxidation is eliminated or reduced to a minimum. After years of hard work and patient study the electric steel furnace has been developed to a point where it is a commercial success and has been heralded by the manufacturers of these furnaces as the ideal method by which to make steel. The claims made for this process are among others, that it is the one method by which the oxidation of the metal can be eliminated or at least reduced to a minimum, being superior in this respect to the old crucible process; that it requires less expert operators to produce the metal; and that the product is superior to that of any other process. There are many advantages to the electric steel furnace in certain lines of work that are admitted by all familiar with the steel industry, but whether or not we have thus reached perfection remains to be demonstrated.

In dealing with the electric steel furnace as the agency of production in steel foundry practice the acid furnace only will be considered in this paper. The method of building up and setting the furnace bottom is of prime importance to the life of the furnace and also to the speed in melting down the charge and bringing it up to temperature. To insure a hard, lasting bottom it should be burned in layer by layer so that the sand is set all the way through and is not merely glazed over the top with a soft spongy interior that will rapidly eat away as soon as the surface is cut into.

Steep Sides

This bottom should be so built that when finished it will be cup shaped rather than saucer shaped. In other words the bottom should be rather deep with steep sides instead of ones gradually sloping up to the side walls of the furnace. In building this bottom up to the side walls care should be taken that no ledge is left at the point where the bottom meets the side walls. There are several advantages to this construction. A bottom of this type permits the charging of a greater tonnage per heat in a furnace of given area and insures the lodgment of the material charged more directly under the electrodes than in a furnace where the bottom is more flat or saucer shaped.

When the heat is melted down on a bottom of this type there is no unmelted material (sometimes called a bear) left hanging to the side walls, which must be pulled loose and into the bath in order to be melted. Where the side walls are steep this material will of its own weight tear loose from the sides and slide into the bath. The precaution in not leaving any ledge at the junction of the bottom and side walls is to eliminate any chance of some of the material charged to lodge there and fail to slide into the bath and so delay the furnace while the operators reach in with a bar or hook and drag it down into the bath. In having the charge thus placed more directly under the electrodes instead of being scattered about over a larger area, greater melting efficiency is obtained from the current used because a higher percentage of the total charge is subjected to the direct flow of the current and is rapidly melted by reason of the great heat generated from the internal resistance of the metal to the flow of the current. Where the charge is scattered only a small percentage is subjected to the internal resistance and the remainder must be melted by radiated heat from the arc or heat conducted from the center of the charge outward to the sides. This radiated and conducted heat is not nearly as high in temperature as the heat generated by internal resistance and a large part of it is lost by radiation from the furnace and to the roof of the furnace. The greater the proportion of the charge that can be subjected to the direct flow of the current the faster will be the melt and the larger proportion that must be melted by radiation and conductivity the slower will be the melt.

In building up a bottom of this type it also is advisable to run the sand up on the back wall above the tapping hole as high as possible. It is the practice at Springfield, O., plant of the Ohio Steel Foundry Co. to run this sand up nearly to the roof of the furnace. This is rather difficult to do but by taking a little time after each tap and building up gradually from just below the level of the tapping hole it finally can be accomplished. The purpose of this built-up back wall is twofold. In tilting the furnace to tap a heat the slag in the metal will rise considerably above the level of the tap hole and will severely erode or cut into the back wall. By having the silica brick in the back wall thus protected by a heavy layer of sand which can be replaced after each tap, the brick themselves are saved from being cut and the life of the back wall is prolonged. In tapping out a heat the furnace can be partially tilted to bring the slag above the tap hole before the hole is completely dug out. Thus, when the hole is later dug out, the metal will precede the slag, providing a slag covering in the ladle without causing the violent intermixture which occurs when the slag comes out with the steel. Another advantage to this high back wall lining is that a larger heat can be charged by the simple expedient of tilting the furnace backward slightly from the perpendicular and letting the metal rest against this heavy lining as it melts. When the whole charge is melted, the furnace can be turned back to the per-

Paper prepared for the convention of the American Foundrymen's association, Columbus, O., by James W. Galvin and Charles N. Ring, Ohio Steel Foundry Co., Springfield, O.

pendicular without danger of the metal running out the charging door.

Much time and cost of electrical current can also be saved by using scrap that is in such physical shape that it forms a compact mass instead of being badly interlaced with large open spaces between the different pieces. A compact charge of this kind offers a more continuous path for current from the electrodes. Where the charge has large open spaces the current is compelled to jump across these open spaces. This entails a reduction in efficiency as a certain amount of heat is lost by radiation, from each jump of the current from one piece to another. Each one of these jumps also reduces the percentage of total current used that could be utilized with greater efficiency by direct passage creating the intense heat due to the internal resistance of the metal. Another factor to be considered is the fluctuation in the load that the power plant is compelled to carry where the charge is not in compact form. In loosely piled charges, the contact does not remain constant but is continually making and breaking due to the fact that no continuous passage is furnished, and as different pieces of the charge are melted they fall away from the electrodes breaking the contact. The electrodes will automatically adjust themseves to form a new contact. Each one of these makes and breaks causes a loss of time and creates a high momentary demand on the power station.

Leaving a Heel

Scrap of a nature to form this compact mass is not always available and when such is the case the following scheme can be adopted. When charging the first heat for a day's run use more metal than you intend to tap off. When the first heat is tapped a certain amount of liquid metal will be left in the furnace into which the new charge can be thrown as quickly as possible. This will result in the whole mass being welded into a solid compact body that offers a continuous passage for the current. This operation can be continued for a day's run with repairs being made to the side walls of the furnace while the heats are being charged. The bottom of the furnace will stand a day's run without being repaired by additions of sand. After the day's run has been made and the furnace drained on the last tap the bottom of the furnace and the side walls can be very thoroughly repaired and made up for the next day's run. In making this additional charge, care should be taken that as much of the slag is drained off from the previous heat as possible and if any amount of slag is left a small quantity of fine ore should be added to thin the slag which has become viscous, otherwise the charge will ride on top of the slag and not thoroughly mix with the metal underneath.

Slag Acts as Insulator

It naturally would be supposed that after a heat has been melted and all becomes a liquid mass the ideal condition for the free and steady passage of the current has been attained. This would be the case were it not for the formation of the slag on top of the metal. As it becomes heavy and thick this slag acts as an insulator to the passage of the current from the electrodes to the metal beneath the slag. In an effort to make contact the electrodes automatically lower themselves and bury their tips in the slag. This adds greatly to the electrode consumption and increases the carbon content of the bath. To eliminate this difficulty it is advisable to add a small amount of fine iron ore to the slag from time to time to thin it. It may then be drained through the charging door as necessary to keep the amount down to proper limits for good metallurgical operation and also so as not to interfere with contact sufficiently to draw the electrodes into the slag.

Another feature to be considered in the speed of melting is the length of the arc from the electrodes. The longer the arc drawn the more it spreads before striking the metal and the greater the radiation of heat from this arc. This radiated heat is relatively low in melting efficiency and proportionately harder on the roof and side walls of the furnace. The length of the arc can be controlled by proper manipulation of the switchboard.

One of the most difficult operations connected with the acid electric furnace is the control of the silicon content of the finished product. This fluctuation of silicon content is primarily due to the high temperatures attained in the electric furnace and the reversal of certain chemical affinities due to this intense heat. In the temperature usually attained in the open hearth, the carbon in the original charge is oxidized by the flame and by the addition of an oxidizer in the form of iron ore. At this temperature carbon has a greater affinity for oxygen than iron has and so will rob the iron ore of its oxygen and pass off in the form of carbon monoxide and carbon dioxide. The sand from which the bottom is made is chemically known as silica and is composed of silicon and oxygen. In the temperature of the open-hearth process the silicon in the sand has a greater affinity for oxygen than has carbon and therefore is not robbed of its oxygen by the carbon. But at the higher temperatures secured in the electric furnace carbon has a greater affinity for oxygen than has silica and so if not prevented will take oxygen from the silica sand and leave silicon. This latter will be absorbed by the metal and thus raise its silicon content. It also is probable that the iron has a reducing effect on the silica sand and silica in the slag. As stated, this peculiar condition is due to the intense heat of the electric furnace and it is thought that the proper way to avoid this trouble is to get the furnace reactions as nearly completed as possible before reaching this high temperature.

This plan is followed at the plant with which the writer is identified. As soon as a heat is melted and before the highest temperature is attained in the electric furnace the carbon content is reduced to the desired per cent by adding iron ore the same as in the open hearth. The heat is treated at this lower temperature and then rapidly brought up to the required temperature and tapped out before further reactions can cause a rise in silicon content. By this method of operation almost complete control of the silicon content has been gained.

Oxidation is Kept Down

Oxidation of the metal in the electric furnace also is a serious factor to contend with even though the method of producing the temperature does not have an oxidizing effect. Oxidation of the metal does take place by reason of the reactions in the furnace during the process of melting and bringing to pouring temperature. In order to insure sound castings care must be taken to free the metal from the oxides formed and gases evolved. The method employed at our plant for accomplishing this runs parallel with our method of silicon control. The temperature of the metal is kept to about open-hearth temperatures and the carbon is oxidized with small additions of iron ore so that there is at no time an excess of iron ore added above which is necessary to lower the carbon to the desired content. Sufficient manganese is contained in the initial charge to insure some residual manganese in the bath at the time the carbon has reached the desired content and also to supply the slag with the proper amount of manganese so that when it reaches a balanced stage of basicity too much

iron has not been oxidized to supply this basicity. The slag also is kept thinned so as not to be highly oxidizing and in order to allow the easy escape of gases formed beneath. When the proper chemical content is reached and the deoxidation of the metal accomplished the bath is brought to a very high temperature as rapidly as possible (usually from five to seven minutes) and tapped out. Additions of manganese and silicon are made in the ladle but usually little silicon is added as the residual silicon in the bath is sufficient to quiet the metal. This residual silicon is absorbed by the metal during the period it is being brought to the high temperature required in the bath before pouring.

In speaking of deoxidizing the metal, the word is used relatively, as complete deoxidation is impossible. The electric furnace permits of more thorough deoxidation than does the open hearth and thus is one more step ahead in the steel industry. However, in order that it may make its way against other methods, steps must be taken to reduce the cost of operation from a fuel standpoint. One of the most logical ways of reducing this cost is to provide better furnace insulation than is available at the present time. More rapid melting also would be advantageous as the shorter the time in melting the less the amount of radiation from the furnace shell during the process of melting.

Novel Method of Sweeping an Elbow Core

BY M. E. DUGGAN

PLANNING the amount of lumber necessary and the best method of cutting it deserves as much attention in the construction of a corebox as it does in the pattern. When the pattern is of such a size or shape that it is economical to build it in pieces it generally will be found equally desirable to build the corebox in a like manner.

Cores for pipe bends, especially large sizes, and smaller sizes where only one or two castings are required, generally

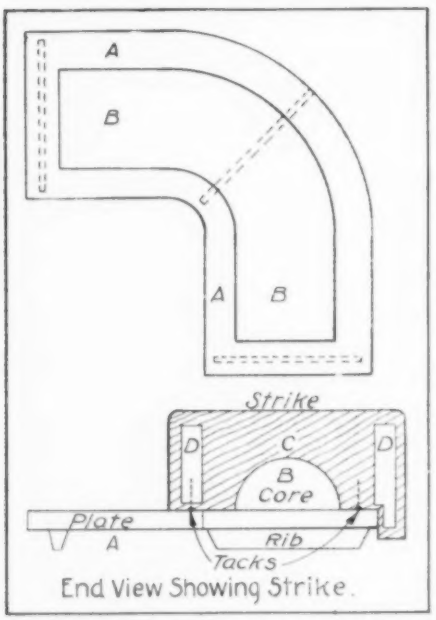


FIG. 1—COMMON METHOD FOLLOWED IN MAKING CORES FOR PIPE BENDS

are swept on plates with suitable frames and strikes. The usual method employed in making the cores is shown in Fig. 1. An original method, original in-so-far as the writer has never seen or heard of it being used elsewhere, is shown in Fig. 2. The process of ramming the sand, arranging the rods or arbors and providing for a vent are alike in both cases and may be touched upon briefly.

Having decided on the total length of the core from end to end, including the prints, a pattern is made from which one or two iron plates are cast. If it is necessary to dry both halves of the core the same night two plates are necessary. Sometimes only one-half of the core is dried the other half being built upon it afterward. Even when two plates are required on account of a non-reversible core, that is one in which the two halves will not match when one is placed on the other for pasting, one pattern is sufficient. The only precaution to be observed is that one half of the core is made on one side of the plate and the other half made with the reverse side of the plate turned up. When plates are provided with ribs, two patterns are necessary.

In Fig. 1 *A* represents the plate; *B* the core and *C* the strike. The latter is cut from a piece of board ranging in thickness from 3/8-inch to 1 inch, depending on the size of the core. The semicircular gap in the strike determines the diameter of the required core. The grain of the wood may run in the direction of the arrow. It is strengthened if necessary by two battens shown at *D D*. The edges of the semicircle are beveled which enables the strike to work more smoothly and correctly over the body of sand forming the core.

A few flat-headed tacks or nails should be driven in flush with the face of the strike which comes into contact with the plate to prevent it from wearing away and thus altering the shape of the core.

The coremaker places enough material on the iron plate to form one half of the core. He rams it firmly and shapes it roughly by hand to correspond approximately to the required shape. The sweep, with a shoulder held in close contact with the edge of the plate is then drawn from end to end. The semicircular gap leaves the desired shape on the plate while the surplus material is removed and returned to the core-sand pile. Small inequalities are made up by hand and the sweep passed over the face several times until the shape is perfect.

The plate, the sweep or strike and the material forming the core are shown in the end view Fig. 1. The position of the tacks on the edge of the sweep also are indicated.

An improvement on this method is shown in Fig. 2. In this method it is not necessary to make special drying plates. Any plate large enough will answer the purpose. The hinge piece E is simply a plain piece of board provided

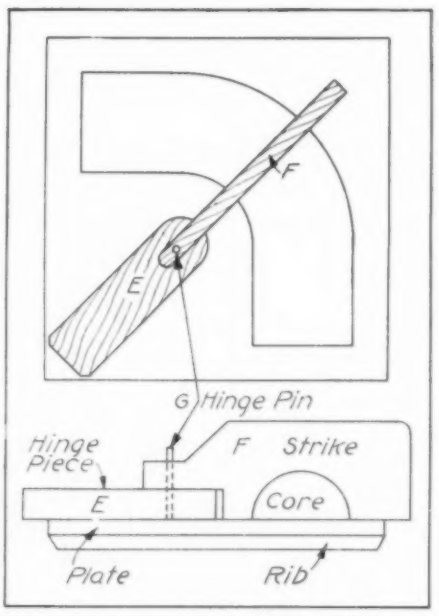


FIG. 2—SUGGESTED METHOD FOR MAKING PIPE BEND CORES

with a 1/2-inch hole at one end and clamped to the plate at the other end. The strike is also a plain piece of board provided with a 1/2-inch hole near one end which slips over the dowell pin in the hinge piece. This strike swings in the arc of a circle and forms the curved portion of the core. The straight part is formed by a strike similar to that shown in Fig. 1 and drawn along the edge of the plate at the upper and lower edge.

Develops New Device for Locating Pattern

A patent has been granted H. S. Hanstine, Meadville, Pa., on a special type of match plate, the application of which is shown in the accompanying illustration. It is claimed that this plate is especially adaptable where a limited number of castings are ordered from a given pattern and to other cases where it would not pay to make a regular pattern plate. With this device any handy man or boy in the foundry can mount a pattern in a few minutes. He will not need to employ either a rule, square or center line.

All that is necessary is to bore three holes through the pattern with both halves clamped together; or bore one hole near the center and use the two regular dowel holes with which the majority of split patterns are provided. In the case of circular patterns in which it is not necessary for the two halves to register in any particular relative position one hole in the center will be enough.

Briefly described the match board is made to conform to the size of a standard flask. It is provided at each end with suitable pins, *A*, *A*, Fig. 1, for locating the flask. Two flat, shallow grooves are provided on the working face of the board. One extends from end to end and the other from side to side. They cross in the center of the board. Three guide pins, shown at *B*, *B*, *B*, Fig. 2, and in detail in Fig. 3, are employed for locating the pattern. These pins slide in the grooves and readily adapt themselves to pin holes in the pattern. When the three pins are in place the pattern is locked and cannot shift.

After the required number of drags are rammed, the two pins in the longitudinal groove are left in position to locate the other half of the pattern. The third pin is shifted from one side to the other of the transverse groove.

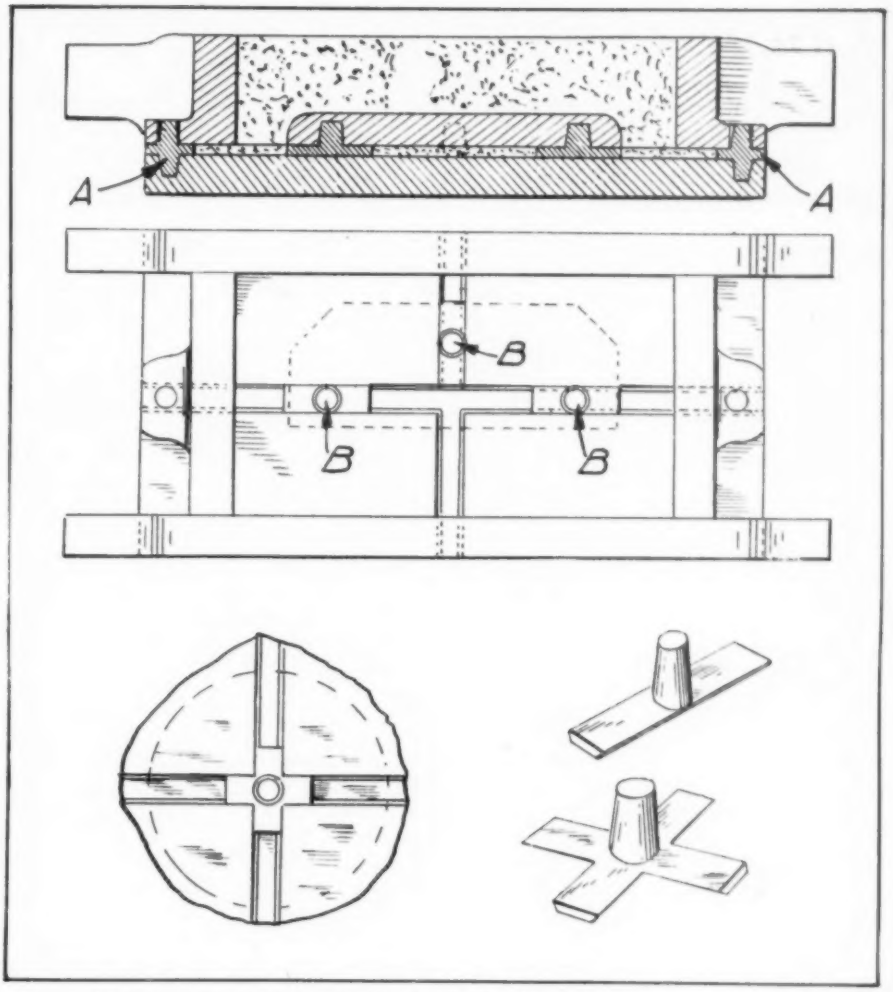


FIG. 1—SECTIONAL VIEW SHOWING DETAILS OF FLASK AND PATTERN PINS FIG. 2—PLAN FIG. 3—ONE OF THE GUIDE PINS FIG. 4—APPLICATION OF THE PATTERN BOARD TO CIRCULAR PATTERNS FIG. 5—GUIDE PIN USED IN CONNECTION WITH CIRCULAR PATTERNS

Transferring a Reduced Sketch to a Board

By M. E. Duggan

During my apprentice and early journeyman days as a patternmaker I found it extremely difficult to avoid making mistakes when attempting to transfer a reduced or scaled drawing to the layout board in the shape of a full size or working drawing. One of the causes of these mistakes lay in an attempt to transfer too many lines. Another cause of confusion lay in drawing lines by mistakes and letting them stand instead of removing them. I have seen drawings made in this way that were so complicated that it was out of the question for any person except possibly the one who made the drawing and the pattern to check up the pattern after it was made.

It must not be inferred from the foregoing that a patternmaker who makes a complicated drawing is not a practical man. On the contrary it would appear that these men must have wonderful power of concentration to be able to visualize the object one of these drawings represents and make a pattern accordingly. However, the practice is not recommended.

When laying out a full size working drawing on a board, or for that matter any drawing, it is advisable to set down no more lines than are necessary; and also to make those lines just so dark as is consistent with the distinction of the work. In other words make the lines forming the outline of the object dark, clear and distinct; while the construction and other lines should be made distinct but lighter.

There is an arbitrary rule in some shops that a patternmaker must reproduce every line on a drawing. This rule while designed to prevent mistakes of omission, in my opinion is the direct cause of many mistakes of confusion, especially in a drawing that is extensively detailed.

It is often beneficial to draw or finish one part of a drawing before touching any of the other parts. By making the lines of that part heavy and distinct it prevents confusion, serves as a reference and is an aid to accuracy.

Opens New Offices

The Mesta Machine Co., Pittsburgh, Pa. has opened a branch office at Chicago, temporarily located in the Railway Exchange Bldg., which will be moved to permanent quarters in the McCormick building after April 1. The Chicago office will be in charge of C. J. Mesta, second vice president of the company. W. R. Dawson and R. W. Schutte will be transferred from the Pittsburgh offices to Chicago.

The company also recently has opened offices in the Singer building, New York. These are in charge of M. M. Moore who formerly was export sales manager at Pittsburgh.

Correcting Flaws in Metals and Mixes

Problems of the Gray-iron, Malleable and Steel Foundry Discussed

By H. E. Diller

Iron Mixture Should Be Based on Analysis

Question—Would the following mixture be satisfactory for making mine-car wheels?

No. 2 Foundry pig iron.67.8 per cent
Returned scrap .....28.0 per cent
Steel scrap ..... 4.2 per cent

Answer—The silicon as well as the phosphorus in such a mixture would probably be higher than is ordinarily used. The high silicon would prevent the tread of the wheel from being chilled as deep as generally is considered advisable. The high phosphorus would weaken the iron somewhat and increase its tendency to crack. Manufacturers who make the highest grade of mine-car wheels work from chemical analyses and calculate their mixtures on this basis. This method, we believe, is the only correct one to secure the best results. Charcoal iron is used in the mixture to the extent of from 10 to 25 per cent.

Castings Left in the Mold Are Not Softened

Question—We want to know what is the general practice in regard to leaving castings in molds. We dump our molds shortly after they are poured but are informed that if castings are permitted to remain in the molds until they are black, they will have little scale and we can use faster speeds and heavier speeds in the machine shop. Please also advise us whether or not there is any device or instrument to test the hardness or scale on castings.

Answer—We could answer your question much better were we more fully informed in regard to the quality of the metal, the size of castings and the kind of sand you are using, besides having some of your castings for inspection.

Ordinarily hardness in castings would not be caused by dumping the molds after the castings have come to a dull red heat. Scale on castings is caused by the sand burning into the metal, and this could be remedied by putting a sea-coal facing in the sand, or by securing a more refractory sand. However, from your letter we do not feel certain that your difficulty is due to scale, as it may be due to hard spots on the surface of the metal. The remedy then would be to correct the mixture and to see that the sand is not too wet in places.

Hardness of the metal at the surface could be measured either by a scleroscope, a Brinnell machine or a Brinnell meter, but we do not think any of them would be entirely satisfactory for detecting hard spots or burned-in scale. On larger castings where the scale burns into the metal, it is sometimes found expedient to take a little deeper cut of the metal to get the nose of the toll well under the scale.

Eliminating Gas Holes in Iron Castings

Question—We would like to secure some information in regard to the prevention of what may be termed gas bubbles in castings, that is, the kind of holes which sometimes appear after the surface of the casting is machined.

Answer—Gas bubbles might be caused by portions of the mold being excessively wet and the sand in the mold being too dense to carry off the steam and gases which are generated. Naturally the remedy for this would be to see that the sand is tempered properly and is of an open grain well vented.

Another cause of gas bubbles is oxidized and highly sulphurous iron. If the iron is being oxidized in the cupola more care should be taken with the smelting method to see that the bed of coke is not too low and does not become too low due to insufficient coke being placed between the charges. If the sulphur is too high in the iron it can either be lowered or nullified through proper means. To lower the amount of sulphur it would be necessary to take precautions to secure low-sulphur scrap and to melt with low-sulphur coke. However, precautions can be taken so as to pour high sulphur iron satisfactorily. These would be to pour the iron hot and to add 3 to 4 pounds of pea-size 80 per cent ferromanganese to a ton of metal in the ladle. The manganese in the alloys will form manganese sulphide with the sulphur in the iron and tends to eliminate the bad effect of the high sulphur contents. The addition of manganese will also be of assistance in case the iron is oxidized.

Even a High-Silicon Iron May Be Too Hard

Question—Should an iron with silicon 3.04 per cent, sulphur 0.066 per cent and manganese 0.51 per cent be soft enough to be drilled at high speed and readily machined when poured into castings weighing from 1 ounce to 5 pounds? We sometimes have trouble with it being too hard.

Answer—Iron of the composition which you give should be soft enough to be drilled on high speed. However, it is possible that if the mold is extra damp and the iron poured extremely hot, that chilled spots may be developed in thin sections of the casting. We would recommend that the silicon be kept as near 2.75 per cent as possible and that you add 3 to 4 pounds of pea-size ferromanganese to a 1000 pounds of iron in the ladle. This will soften the iron in case the sulphur runs too high as it may with poor coke. The manganese will act as a deoxidizer and tend to soften the iron if it becomes oxidized by improper melting.

Open Hearth Used to Make Semisteel

Question—I have read with interest an article in an old issue of THE FOUNDRY entitled "Learn Semisteel Facts from Shell," and would like to know if you think it would be according to good practice to make semisteel in a five-ton, acid-lined, open-hearth furnace, oil fired.

Answer—It would be entirely feasible and according to good practice to make semisteel in an acid-lined open-hearth furnace. You should get a good grade of metal from such a furnace, even without the addition of steel to the mixture. The method of melting would be more expensive than melting in a cupola but a metal with lower carbon would be obtained.

The mixture should consist of pig iron and gray-iron scrap with a small amount of steel scrap. The amount of pig iron to be used would, in a measure, be determined by the amount of suitable gray-iron scrap you have on hand. If you have plenty of scrap to use with it, 30 per cent of pig iron

would be sufficient. The amount of steel scrap which you should use will be determined by the amount of carbon which is burned out in melting the mixture. The finished metal should have approximately 2.75 per cent total carbon. A somewhat stronger metal can be obtained if the carbon is reduced to around 2.50 per cent. This may be effected by burning out the carbon in the furnace but it would be preferable to reduce the carbon by additional steel scrap. About 2.0 per cent of silicon should be carried by the finished metal. However, the amount should be varied according to the thickness of the casting which you make. For lighter castings the silicon could be as high as 2.50 per cent to advantage.

Care should be taken to see that the manganese in the finished metal is not under 0.50 per cent and it could go as high as 0.80 without detriment to the metal. It may be necessary to add silicon and manganaese to the bath of metal. Silicon may be added in the form of ferrosilicon, or as high-silicon pig iron. Manganese may be added in the form of spiegeleisen or ferromanganese. Spiegeleisen should be added in the furnace shortly before tapping. Ferromanganese could be added either in the furnace or in the ladle. A more uniform mixture is secured by adding the ferromanganese in the furnace, but more of it becomes oxidized in melting.

Novel Core Oven Solves Warping Problem

BY STEPHEN B. PHELPS

FOUNDRY superintendents in the past were not only expected to be expert in foundry practice but were required to have ability to design and construct their equipment as well. The present day foundryman as a rule does not have to use his ingenuity in designing machines, ovens, etc., because the many equipment manufacturers with their numerous standardized designs can usually supply his needs from stock and thus allow him to concentrate on such matters as production and quality of castings. However, it sometimes happens because of lack of space, peculiar operating conditions, or immediate needs, that the foundryman still has to be his own engineer. Such was the case when the writer was called upon to replace an oven which had been blown up, due to the carelessness of the colored operator, shortly before the writer took charge of the shop.

Combustion Chamber Troubles

One of the disadvantages of oil burning for baking cores—especially, if as in this case there is not enough room for a well designed combustion chamber—is the intense heat developed which causes frequent relining of the combustion chamber. If the oven is of the truck style with wheels attached and especially if the burner operates between two trucks, the rails, wheels and truck itself may be cracked and twisted out of shape by the heat.

Due to the lack of space the trucks in this oven were crowded too close together and the heat cracked the wheels, warped the truck frame and twisted the rails to such an extent that the repairs were excessive. It frequently took about 20 men with chains and a man on each wheel with a bar to get the truck out. When properly lubricated the truck described in this paper can be pulled out by two men.

The truck does not run on rails but is carried by trolleys which run on overhead I-beams. This novel idea eliminated the trouble in operating the trucks by placing the running gear and tracks where the heat could not affect them.

The new design besides giving quick service for cores pays for itself in about two years by greatly reducing the cost of repairs and the time saved by having two men move them instead of 24.

The trucks are designed with the doors attached forming the end of the truck so that when one truck is drawn out for a new load, the back end of truck acts as a door and closes the oven, permitting access to one truck while the cores on the other truck are baking. This presented another problem in design as the trucks could not be drawn completely out of the oven and in this case it is not practical to build a longer oven or design another complete truck. In order to overcome this difficulty the writer designed two brackets for carrying the front end of the truck and a similar pair for the back end, but in this case the brackets and the trolleys extended through the rear wall, cast iron covers being designed to enclose them. This permitted the use of the entire oven space and the former truck frame which was designed with adjustable bars for carrying cores of different sizes.

The construction for the new oven for overhead travel consists of three columns erected along the side of the oven and three cross beams supported by the columns and the wall on the other side of the ovens. Four I-beams are suspended by turnbuckles from the cross beams to act as tracks for the trucks. The tracks are kept from swaying when the trucks are moved by braces connecting them with the columns and walls. Turnbuckles are used to suspend the tracks to insure their being level and to make them adjustable in case anything should throw them out of line. They are convenient but a less expensive hanger could be used. The three columns are tied together with a long angle and the same shapes are used as braces from the columns to the tie piece. The cross beams are tied to the wall with bolts.

Economy in Construction

It may be thought that these structural pieces were an additional expense aside from the building of the oven. However, it will be seen that in nearly each instance they or some other shape would be required if the usual type of oven were being built and some other pieces not required in this design would be used in addition. For instance, the overhead I-beams replace the tracks in the floor and do not require the customary metal ties or spreaders, nor the customary cement foundation which usually also means a cement floor. The columns replace the customary buckstays and the cross beams replace tie rods, although their costs no doubt are greater.

Three doors were hung on hinges on the walls of the oven to permit observation of the cores and the combustion. They also act as a vent so that the doors can blow open in case another careless operator causes an explosion. Standard trolleys were used in this case but they are not designed for such service and should be provided with special means for convenient lubrication in close quarters.

The Peabody Supply Co., Wabash Bldg., Pittsburgh, recently has been appointed representative of the Cleveland Flux Co., Cleveland, for distribution of the latter's product in West Virginia, eastern Ohio and western Pennsylvania.

Paper presented at the convention of the American Foundrymen's association, Columbus, O., Oct. 5, by Stephen B. Phelps, Jones & Laughlin Steel Co., Pittsburgh.

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Competition Brings Progress

COMPETITION again is at hand. No longer must the customer go from shop to shop, seeking castings. The present stagnation in the foundry industry which cannot last a great while longer, probably will be followed by a period when readjustments must be made in every plant to meet conditions of trade which have been absent for over five years. In times past, foundrymen have been on the defensive in periods of keen competition. Price formed the most important consideration upon which casting contracts were obtained. Bidding against each other, foundrymen cut prices beyond reason and working under hazy cost finding methods ran many a good plant into the receivers' hands. Today most of the important establishments of the country know their costs, and can bid upon castings with assurance that they can make a profit upon the price charged. Many at present are unfortunately possessed of considerable quantities of raw materials. Shops, which until the past few months have been begging for iron and coke have been flooded with shipments. A certain loss will accrue which will have to be absorbed in the price received for work during the next few months. Many anticipating this condition, have charged off the loss on raw materials against 1920 inventories, and now stand ready to quote upon a basis of present market prices for metal and fuel. The price phase of the present situation thus will be handled with greater intelligence than in past similar periods of activity following depression.

At the best, price competition is a passive factor. It is brought about through necessity, is forced upon the manufacturer without his seeking, and can be compensated only through reducing costs of production. Survival under the conditions at hand will require a much more active and aggressive kind of competition. Expansion of foundry facilities, while not greatly beyond the normal needs of the country will result in many instances in changes in the character of work solicited by different foundries. Better operating efficiency will be sought to obtain or hold work in the shops and foundry practice in general will benefit. However, the real growth and development which will attend this period should be directed along other channels. The full possibilities of the castings industry are not appreciated, except in certain limited lines. Betterment in metallurgical and physical properties has opened new fields to the malleable iron and steel casting manufacturers in competition with rolled, pressed and forged products. Special gray iron mixtures have been found of service in making small hardware and tools which commonly are drop forged. Betterment in methods and quality have been under way in the cast-iron pipe field, where the foundry product has maintained its position successfully in the past. Die-casting and the production of small nonferrous parts by the use of plastic molds are being brought forward to meet a decided need in modern repetition work. Alloy steel milling cutters, gears and dies for machine work have been cast instead of forged and the production of these tools and appurtenances in the foundry promises well. All of these developments are but in their initial stages. They require for their complete success just such industrial conditions as are at hand. Competition within the industry will be strong, but the greatest promise of progress lies in entering new fields.

Trade Outlook in the Foundry Industry

ALTHOUGH there is no definite basis upon which to establish a feeling of optimism as to the immediate future in American industry, a generally more hopeful atmosphere prevails. The abnormally slack condition it is thought will correct itself. Just as the feverish buying period of the past year was self accelerated, rising prices inducing further spending, and still higher prices, it is felt that the complete stagnation will react within a short period to bring a normal demand for manufactured goods in all lines.

Turning Point Sought

As has been pointed out previously, the buying power of the public is curtailed by unemployment. Unemployment has increased to a startling degree in the past two months. In consequence there has been a certain amount of accumulation of manufactured goods, but in this period it has not reached the point where actual over-production may be said to exist. It seems probable that at this time, the ultimate demand will more than absorb the small stocks which have been built up during the slowing down period. Therefore, when buying is resumed, as it must soon be, though the purchasing power of the public is lessened, the demand quickly will overtake the supply, and industry will attain full activity within a short time. The turning point cannot be far distant. It will be reached only when price recessions tempt buyers through the realization that the low level is reached. Contrary to the widely expressed opinion, our railroads are not in the broken down condition as regards trackway, rolling stock and motive power that has been announced. This impression, though widely held, is denied by many in charge of actual operation of the lines. Had the abnormal conditions of last spring and summer prevailed, the transportation facilities of the country would have been inadequate. But under present conditions or even under normal average activity, it is probable that the needs of the roads for new appurtenances would not be exceptionally large. However, the railways realize that when they come to carry the full burden again they will have to be in better condition, and many anticipate making extensions and betterments which will require a large volume of equipment. They are not going to make purchases until prices reach a stable level, and their estimates of present requirements are shaded down to lessen the effect upon the present market prices. With the steady recession in iron and steel, a point will be reached soon, when the railroads will begin to buy, and the effect will be felt throughout all the industrial world. This time cannot be predicted any more than can the time when building material and labor costs will bring into the market the requirements which have been accumulating through the past four year period. A comparison of the prices given on this page with those published two weeks ago shows a remarkable and general decline in foundry raw materials.

Prices Still Declining

Coke still remains at practically the same figure, although some for immediate delivery has been sold as low as $5 a ton at the ovens. Scrap has declined in price throughout the country, and pig iron has fallen from $2 to $4 a ton. The production of pig iron in December registered a new low point for 1920, and the indications point to still further loss in January. According to figures compiled by *The Iron Trade Review*, the total production for December was 2,703,872 tons which shows a loss of 231,209 tons as compared with the November total of 2,935,081 tons. The total production for 1920 was 36,404,572 tons, a gain of 5,825,842 tons over the 1919 total of 30,578,730 tons. The total merchant iron figure for 1920 is 9,179,987 tons which is 1,905,029 tons greater than the 1919 total of 7,274,958 tons. This is a gain of 26.2 per cent in the production of merchant pig iron. The average daily production of merchant iron in December was 18,999 tons, which as compared with the November figure of 23,500 tons gives a loss of 4501 tons per day or about 23.8 per cent. This is fairly indicative of conditions in the production of foundry iron. The complete absence of any inquiry has caused many furnaces producing foundry iron to blow out, rather than pile iron at the prevailing market. In the merchant class, 23 furnaces were blown out during December and none was blown in. On Dec. 31, only 213 stacks were in operation while the close of November saw a total of 255 working. Foundry operations have not shown great improvement since the holidays. A few of the automobile factories have opened on reduced schedules, but little demand for automotive castings is noted. Agricultural implement manufacturers still are affected by the slump in farm produce quotations. In the South, mining and oil producing have slowed down to a degree which has had a reaction on the foundry industry of that section.

Prices of Raw Materials for Foundry Use

CORRECTED TO JAN. 6

Iron		Scrap	
No. 2 Foundry, Valley	$32.00 to 36.00	Heavy melting steel, Valley	$15.00 to 15.50
No. 2 Southern, Birmingham	35.00	Heavy melting steel, Pittsburgh	15.00 to 16.00
No. 2 Foundry, Chicago	35.00	Heavy melting steel, Chicago	15.00 to 15.50
No. 2 Foundry, Philadelphia	34.50 to 37.00	Stove plate, Chicago	21.50 to 22.00
Basic, Valley	30.00	No. 1 cast, Chicago	20.00 to 20.50
Malleable, Chicago	35.50	No. 1 cast, Philadelphia	26.00 to 27.00
Malleable, Buffalo	34.50	No. 1 cast, Birmingham	21.00 to 23.00
Coke		Car wheels, Iron, Pittsburgh	21.00 to 22.00
Connellsville foundry coke	$6.50 to 7.00	Car wheels, Iron, Chicago	22.00 to 22.50
Wise county foundry coke	12.50	Railroad malleable, Chicago	16.50 to 17.00
		Agricultural malleable, Chicago	16.50 to 17.00

During December a new low level was struck in nonferrous metal prices. The comparative average prices for November, December and average for the year follow:

	Straits tin	Casting copper	Lead	Zinc	Antimony	Aluminum remelted
November average	36.88	14.21	6.29	6.35	6.07	24.53
December average	33.96	13.14	4.75	5.82	5.48	22.97
1920 average	....	17.89	8.25	7.8	...	....

New York quotations of Jan. 6 follow: Casting copper, 12.37½c; lead 4.75c; Straits tin, 38.50c; antimony, 5.12½c to 5.25c; aluminum, No. 12 alloy, producer's price, 27.50c and open market, 20.00c to 23.50c. Zinc is 5.50c to 5.60c E. St. Louis.

Personal

DR. F. G. COTTRELL has resigned his position as director of the United States Bureau of Mines, to become chairman of the division of chemistry and chemical technology of the National Research Council. H. Foster Bain of California has been recommended as Dr. Cottrell's successor. Mr. Bain was educated and trained as a geologist and mining engineer. He was one of Herbert Hoover's assistants in London on the Belgian relief work during the war. Before that he was editor of the *Mining and Scientific Press*, San Francisco, and later was the editor of the *Mining Magazine*, London, England. He made some important mining investigations in south and central Africa and later undertook similar investigations in China. At one time he was a mine operator in Colorado and once was connected with the United States geological survey. Subsequently, he was the first director of the geological survey of Illinois.

Frank M. Welsh has resigned as New York district manager for the Iron Trade Products Co., of Pittsburgh, effective Jan. 1, to assume charge of the Pittsburgh office of the Detroit Graphite Co.

Thomas M. Platt, assistant engineer, the Southwark Foundry & Machine Co., Philadelphia, has resigned to represent manufacturers and do general engineering work. His headquarters are 722 Drexel building.

Lawrence A. Daly, formerly assistant sales manager of the Hill & Griffith Co. at Cincinnati, and prior to that connected with the John M. Glass Co., Indianapolis, Ind., has become associated with the Carlo-Costley Foundry Supply Co., Pittsburgh.

H. L. Deane, formerly manager of the compressor and engine sales division of the Chicago Pneumatic Tool Co., has resigned and has been succeeded by J. F. Huvane as eastern manager with offices at 6 East Forty-fourth street, New York, and G. C. Vandenboom as western manager with headquarters at 300 North Michigan boulevard, Chicago.

N. J. Ross, treasurer of the Beloit Iron Works, Beloit, Wis., has severed his official connection with the company on the completion of 50 years active service. He still retains his interests in the company but has relinquished his part in the active management. Mr. Ross began his industrial career in 1870 when he was employed as a casting cleaner in the Merrill & Houston Iron Works. He passed through various stages of advancement in the shop until 1885 when the Beloit Iron Works was organized to succeed the original concern, he was appointed shop superintendent. From 1898 to 1905 he was secretary of the company and from 1905 to 1916 was secretary and treasurer. With the reorganization in 1916 under which E. H. Neese was made vice president and Hamilton N. Ross secretary, Mr. Ross became treasurer.

Manufacturers Murdered by Band of Gunmen

W. C. Sly, president of the W. W. Sly Mfg. Co., Cleveland and G. K. Fanner, superintendent of the same company were shot and instantly killed on Dec. 31 by members of a band

W. C. SLY

of desperadoes who held them up as they returned from the bank with the money to meet the plant payroll. That the crime was deliberately planned is evident from the manner in which it was committed and also from the evidence of several witnesses who were passing the scene of the tragedy at the time. In view of the many robberies and other crimes of violence staged in Cleveland in recent months Mr. Sly was accustomed to go armed in his periodical trips to the bank. As the machine in which he and Mr. Fanner were returning with the payroll was leaving the end of a temporary bridge over the Nickle Plate railroad tracks near West 47th street, Cleveland, another machine carrying several men darted out of a side street and swung across his path. To avoid a collision, Mr. Sly swerved and drove his machine into the railing of the bridge. Following the usual custom in traffic accidents he stepped out of his car and with pencil and note book in hand approached the other car, which also had stopped, to secure the license number and to remonstrate with the reckless driver.

He was met by two men from the other car, one of whom immediately fired point blank, killing him instantly. On hearing the shot, Mr. Fanner grabbed the grip containing the money and jumped out of the car. Before he had taken two steps the second robber fired twice and killed him. One of the gunmen then snatched the satchel and the whole party abandoning the machine in which they had arrived, jumped into a second car which had been held in readiness by a confederate and disappeared.

Mr. Sly, 58 years old at the time of his death, was the son of W. W. Sly and Mary Banks, natives of New York state who had settled in Michigan shortly after they were married. W. C. Sly was born on a farm in Oakland county, Michigan, on Sept. 15, 1862 while his father was serving in the Union army during the civil war. In fact the boy was two years old before his father saw him. The family remained in Michigan for about five years after the elder Mr. Sly was mustered out of the army and then moved to Cleveland. They have been located in that city ever since.

Having finished the ordinary high school course, W. C. Sly started as a helper in the Cleveland Nickle Works, a small shop conducted by his father. He rapidly assimilated the details of the business and as his father gradually allowed him to assume more and more responsibility he enlarged the scope and extent of the company's activities to include core ovens, tumbling machinery, sand blast installations, cupolas, fans, dust arresters, and sand reclaiming equipment. He was vice president and general manager for several years and on the death of his father he was elected president. Under his direction the business of the company expanded to such an extent that the old plant was outgrown. Large new buildings recently have been erected and equipped with the most modern machinery increasing the capacity of the plant about 300 per cent.

Mr. Sly was one of the oldest in point of membership of the Cleveland Yacht club. He was an enthusiastic member and chairman at various times of important committees appointed by the Industrial Association of Cleveland. He was a strong believer

in and advocate of means tending to promote better and more harmonious relations between employe and employer. He is survived by a widow, to whom he married on April 18, 1894, and also by his mother and one sister Mrs. E. C. Hoffman, all of Cleveland.

G. K. Fanner, the second victim of the shooting was the son of G. J. Fanner founder of the Fanner Mfg. Co., Cleveland; but for the past 12 years vice president of the W. W. Sly Mfg. Co. The yonug man started with the company as a machinist and gradually advanced to the position of superintendent, a position he held at the time of his death. He is survived by a widow and one daughter.

Obituary

JOHN FRANCIS NEILLS, vice president of the Charles C. Kawin Co., Chicago, died recently at his home, 6538 Greenview avenue, Chicago, aged 54 years, after an illness lasting only a few days. His death was hastened by a slight stroke together with his general low vitality, due to Bright's disease. From early boyhood until his death, Mr. Nellis has been connected with the foundry industry, working in almost every capacity from helper to superintendent, and during all this time he never missed an opportunity to help improve the conditions of his fellow workers.

Thomas Thornly Booth, for 30 years purchasing agent of the Crompton & Knowles Iron Works, Worcester, Mass., president of the Standard Foundry Co., of that city, and one of the founders of the Philbrick-Booth Foundry Co., Hartford, Conn., iron founder, died unexpectedly at his home in Worcester, Dec. 20, aged 63 years. Mr. Booth was about his work until a week before his death, which was caused by diabetis. Since Feb. 26, 1913, he has been a director of the corporation of the Crompton & Knowles Loom Works. His son-in-law, Halsey R. Philbrick, has charge of the Hartford foundry.

Opens St. Louis Office

The Cutler-Hammer Mfg. Co., of Milwaukee, has obtained office space in suite 2111 Railway Exchange building, St. Louis, in which it has established a branch of the Chicago district office to take care of increasing business in St. Louis territory. Harold Phillips, formerly of the engineering department and later office manager in Chicago, will be in charge.

Hear Talk on Grinding

At the December meeting of the Hartford Branch of the American Society of Mechanical Engineers, A. Rousseau, safety engineer of the Norton Co., Worcester, Mass., spoke on "The Prevention of Grinding Wheel Accidents."

There are two methods, he said, of preventing accidents. One is to have suitable guards so as to minimize the damage done in case a wheel breaks, and the other is to see that the design of the wheel and its operating speed are such as to prevent breakage. Of course this latter method is preferable. Light guards and the proper design of grinding machines are, however, necessary to prevent hand abrasion during operation. W. H. Chapman, of the engineering department of the Norton Co., spoke of the great advance in grinding during 1920. In this year, he said, the art of grinding became a science. His paper was illustrated with lantern slides, and showed typical cases of accurate grinding operations, and many unique developments of the year in machine design. Both papers were followed by active discussion.

Elements in Iron Will Control Mixtures

(*Continued from page 65*)

lute control in smelting iron. Pig iron can be produced with any amount of silicon from about 0.50 per cent to 20 per cent. In regular grades of foundry iron it runs from 1.25 to 3.25 per cent. Although manganese can be controlled to a certain extent in the smelting operation, it is impossible to produce a high-manganese pig iron from a low-manganese ore, or vice versa. In foundry irons made in this country manganese ranges from about 0.15 to 2.50 per cent. Phosphorus cannot be controlled by the blast furnaceman. In producing pig iron from ore, the pig inherits the total amount of phosphorus that was contained in the ore. Pig iron is produced in this country with phosphorus as low as 0.03 per cent, but this is a special iron. Phosphorus in foundry pig iron is generally between 0.40 to 1.50 per cent. All the carbon in pig iron is absorbed from the fuel in the blast furnace and on the average will be 3.5 per cent in the metal. So of the five elements contained by the iron, manganese and phosphorus are the only ones whose presence in the iron ore remains definite.

Northern foundry pig iron is produced from Lake Superior ores, and southern foundry pig iron is produced from Alabama or Tennessee ores, and generally runs higher in phosphorus than northern iron. Virginia foundry iron, produced from Virginia ores, also averages higher in manganese than northern iron, while eastern Pennsylvania foundry iron, is similar to northern iron.

Equipment Firm Opens Pittsburgh Office

The Northern Engineering Works, Detroit, crane and hoist builder, has established a new office in the Pittsburgh district. The office is located at 990 Union Arcade building, and will be in charge of J. B. Laird, who has hitherto represented the company in western New York and northern Pennsylvania. Mr. Laird is an experienced crane and hoist engineer and salesman and will cover the entire East and Ohio valley, and for the present will look after the Buffalo district in addition.

Issues Exceptional Book

That, That Is. Is, is the title of another booklet edited and largely written by Frederic B. Stevens, Detroit, whose other employment is that of ministering to the needs of foundrymen in providing them with supplies and equipment. This booklet is one of a series published every once in a while, which contains a number of literary gems well worth reading. Among the contributions by Mr. Stevens are included a Christmas Carol, My Last Game of Poker, The Open Mind, Business Letters, My Ten-Minute lecture, and Alone with Death. That advertising genius Lewis Victor Eytinge is paid a glowing tribute for his wonderful accomplishment in letterwriting and common sense in advertising is discussed by H. Willard.

Organize New Company

Organized recently with a capital of $25,000, the Kittanning Foundry Co., 1002 Empire building, Pittsburgh, has commenced to operate a plant at Kittanning, Pa., where gray iron castings will be manufactured. F. R. Edmunds, president of the new company, formerly was assistant superintendent of the Dayton Malleable Iron Co., Dayton, O. James W. King is secretary and treasurer of the Kittanning company.

The Factories Equipment Co., 1202 Illuminating building, Cleveland, recently was organized under direction of C. W. Bartlett to sell oil and gas burners, furnaces, carbonizing compounds, magnetic separators, pumps, blowers, motors and refractory cement.

New Preheating Furnace Operates on Oil

A furnace for preheating work to be welded is shown in the accompanying illustration. It consists of a deep box or oven, with detachable cover, mounted on a preheating table. The box is large enough to accommodate a gas engine block of six cylinders and other small parts at the same time. It is provided with three sliding doors through which the operator can watch the work and see that it does not get over heated.

By removing the box and cover the furnace is converted into a preheating table. The combustion chambers through which the flames of the kerosene burners travel are lined with a patented type of refractory brick, which breaks the flame up into a number of small, soft, radiating flames. This is an important item in evenly and thoroughly transmitting the heat to the castings or broken machine parts to be heated.

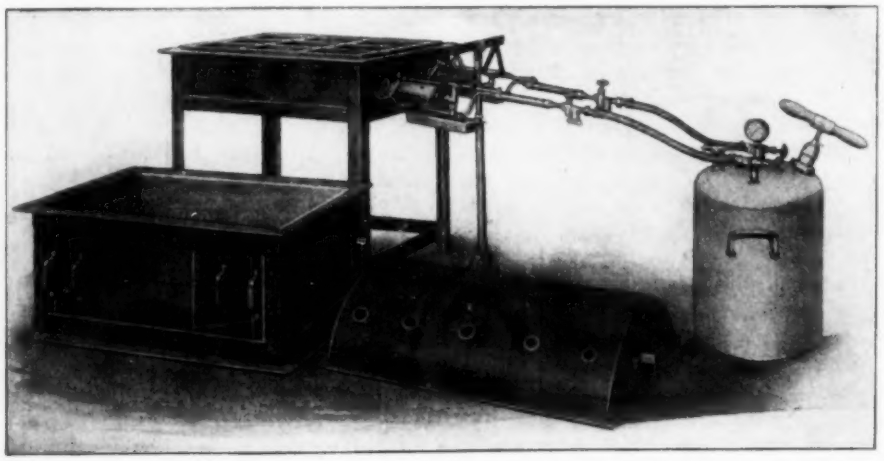
It is claimed that the furnace is particularly desirable for such work as welding gears, crank-cases and other parts with comparatively large areas and of intricate formation. The even heating prevents cracking and avoids any possibility of unequal expansion.

The welder can slide the door open and work piece by piece; or he can use a small welding table with fire brick top, take out one job, weld it, replace it for reheating and then take another. He can take out a job to weld and put another one in its place to be preheated, thus continually rotating the work. After all the parts have been welded they are returned to the furnace and allowed to cool gradually.

The cover and box are not necessary when welding or soldering aluminum crank cases. A small furnace of loose fire brick is built around the case and the flame of one of the preheating burners applied directly.

Frequently for heavy and cumbersome parts the preheating safely can be confined to the break. It is not necessary to preheat the entire casting. Loose fire brick or sheet asbestos are used to confine and direct the flames from one or more burners. The table then is called into service, the work placed on it and the welding operation started.

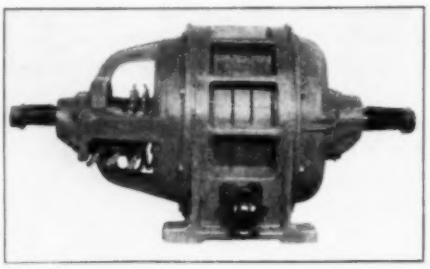
The burner shown in the illustration is the so called hand pump type vaporizing kerosene oil as fuel. The manufacturer, the Hauck Mfg. Co., Brooklyn, N. Y., states that this furnace is employed in its own welding department and has proved to be an economical and indispensable piece of equipment.



THE BOX AND COVER CAN BE USED TO ENCLOSE THE WORK WHILE IT IS PREHEATING AND THE ACTUAL WELDING DONE CLOSE BY; OR THE COVER MAY BE DISPENSED WITH AND THE PREHEATING FRAME EMPLOYED AS A WELDING BENCH

Develops Crane Motor

A new type alternating current motor for operation on cranes and hoists and having several features claimed to be radical improvements over former designs, has been developed by the General Electric Co. The new motors, one of which is shown in the accompanying illustration, are generally smaller in diameter and longer than old design motors of the same horsepower. They also are provided with larger shafts and bearings. In connection with the electrical characteristics it is stated that the maximum stationary torque is twice the running torque at rated frequency and voltage.



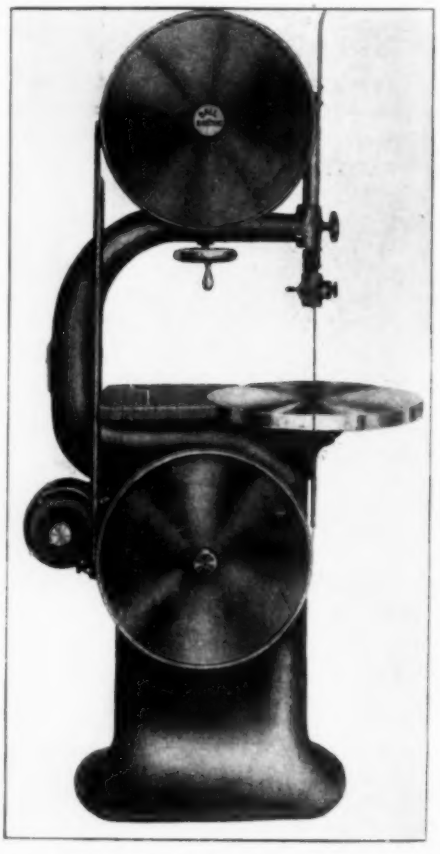
SMALL 440-VOLT INDUCTION MOTOR

All motors up to and including 40-horsepower are rated on a 30 minute, 50 degree Cent. rise and from 50 horsepower up on a 60 minute 50 degree Cent. rise basis.

A new resistor designed for work with the new motors leaves enough resistance in the motor circuit when the controller is on full to cause the motors to run at approximately 89 per cent below full load rated speed when delivering full load torque. Among the advantages to be gained by the use of this resistor or reduced maintenance and smaller maximum current demands. It also is claimed that it protects the motor from abuse either on the part of the operator or from abnormal working conditions.

Motor Driven Band Saw

Among the claims put forth for the band saw shown in the accompanying illustration and manufactured by the Syracuse Sander Mfg. Co., Syracuse, N. Y., is smoothness in operation. It is said to be a perfectly balanced machine, ball bearing throughout, and equipped with a ball bearing, totally enclosed motor built especially for this purpose. Friction is reduced to a minimum and the cost of operation is



A SELF CONTAINED UNIT BAND SAW

lowered, it is claimed by this means.

This motor-driven band saw starts instantly by pressing the switch button It may be placed in any part of the work room that is most convenient, and if necessary may be moved from place to place thus providing great flexibility.

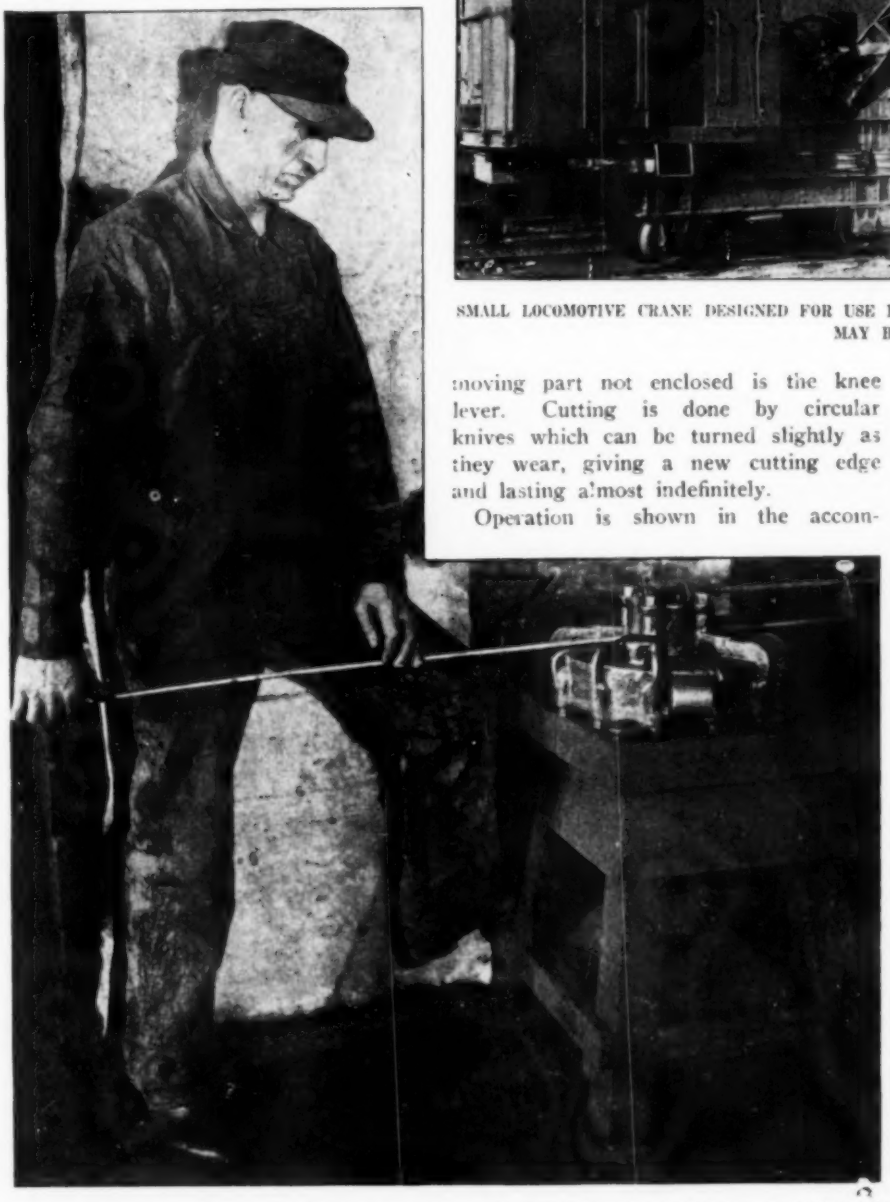
The chain drive running in oil is completely enclosed in a housing. The web wheels eliminate the necessity of erecting the cumbersome guards that are required on spoke wheels by most state factory laws. The table has a ground surface and is provided with a roller guide above and below. The machine is operated from light or power circuit.

Perfects Air-Driven Rod Cutting Machine

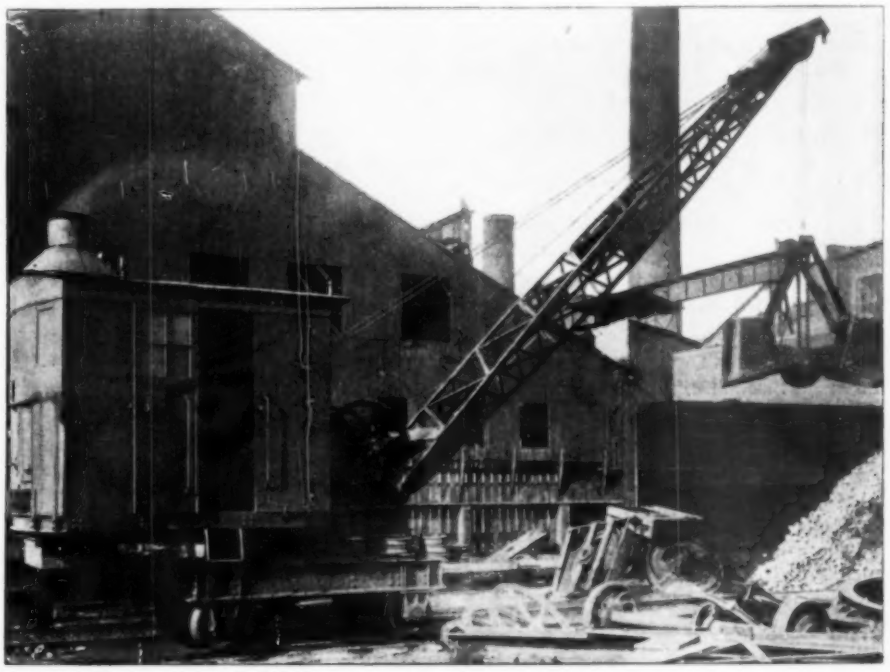
A pneumatic rod cutter designed for foundry work has been introduced by Scully-Jones & Co., foundry equipment and cranes, Chicago It consists of a strongly built piston of considerable area and short stroke, operated by compressed air or steam. It will cut any size within its range without change or adjustment, at a minimum of 60 pounds air pressure. Its design and construction are sturdy to prevent breakage and it will withstand the strain put on it in shearing rods. It is safe in operation, as the only moving part not enclosed is the knee lever. Cutting is done by circular knives which can be turned slightly as they wear, giving a new cutting edge and lasting almost indefinitely.

Operation is shown in the accompanying illustration. The rod is passed through a hole leading through the knives to a gage set on a horizontal rod, according to the length of rod to be cut. Pressure by the workman's knee on the lever admits air to the cylinder, raising the piston, cutting the rod instantly. The cut portion then falls and the rod is advanced for another cut. The piston travels only ½ to ⅝ inch, cutting ⅜ to ⅝ rods.

The machine is adapted for use wherever rods are cut, for the foundry, core room, in machine shops, blacksmith shops, steel mills and bolt plants. It can be installed on permanent benches or made portable by placing it on a bench fitted with wheels. Without any change it can be connected with a steam line and operated in exactly the same way as with air. One size cuts to ⅜-inch diameter and the other to ⅝-inch.



COMPACT ROD CUTTER IS OPERATED BY STEAM OR COMPRESSED AIR—ADAPTED TO DIFFERENT SIZES OF STOCK



SMALL LOCOMOTIVE CRANE DESIGNED FOR USE IN HANDLING YARD STOCKS—BUCKET OR MAGNET MAY BE USED

Designs Locomotive Crane for Light Work

Feeling the need for smaller capacity cranes for plant use, as a result of the economy produced by larger sized cranes, the Brown Hoisting Machinery Co., Cleveland, has produced a new small size locomotive crane. The new crane is shown in the accompanying illustration. In a few minutes time, the machine can be changed to handle a grab bucket, bottom block or magnet, depending upon the material to be handled.

Experience with the larger type cranes has shown them to be well fitted to handle ore, coal, coke, crushed stone, sand and similar materials by bucket.

With the bottom block, all kinds of sling loads are handled and with a magnet the crane will handle pigs, scrap, bars or castings. The new crane, it is said, will do the same work as the larger types within its capacity. It is built to accommodate a 1-yard bucket, hook loads of 5 tons or a 36-inch magnet.

To meet the different working conditions, the new cranes are designed to operate by steam, electricity or gasoline engine. They are built for use on railroad trucks, traction wheels or crawlers.

Battery Truck Charges Annealing Ovens

The storage battery truck shown in the accompanying illustration has been developed by the Elwell-Parker Co., Cleveland, for the specific purpose of conveying pots of malleable iron castings into and out of the annealing furnaces. It is customary to charge the battery with electric power at night by plugging in on an electric rheostat battery charger close switch which automatically opens after seven hours or when the battery is fully charged. With 1-cent alternating current it is claimed that the cost for charging a battery will vary between 15 and 30 cents, depending on the type of battery. A single charge of the battery will enable the truck to make from 150 to 200 trips into and out of the oven.

The entire equipment is assembled on a heavy, steel, hot-rivetted frame. Practically all the parts are made of malleable iron or steel; they are standardized and interchangeable. The machine complete with batteries weighs 3600 pounds and has an overall length of 12 feet.

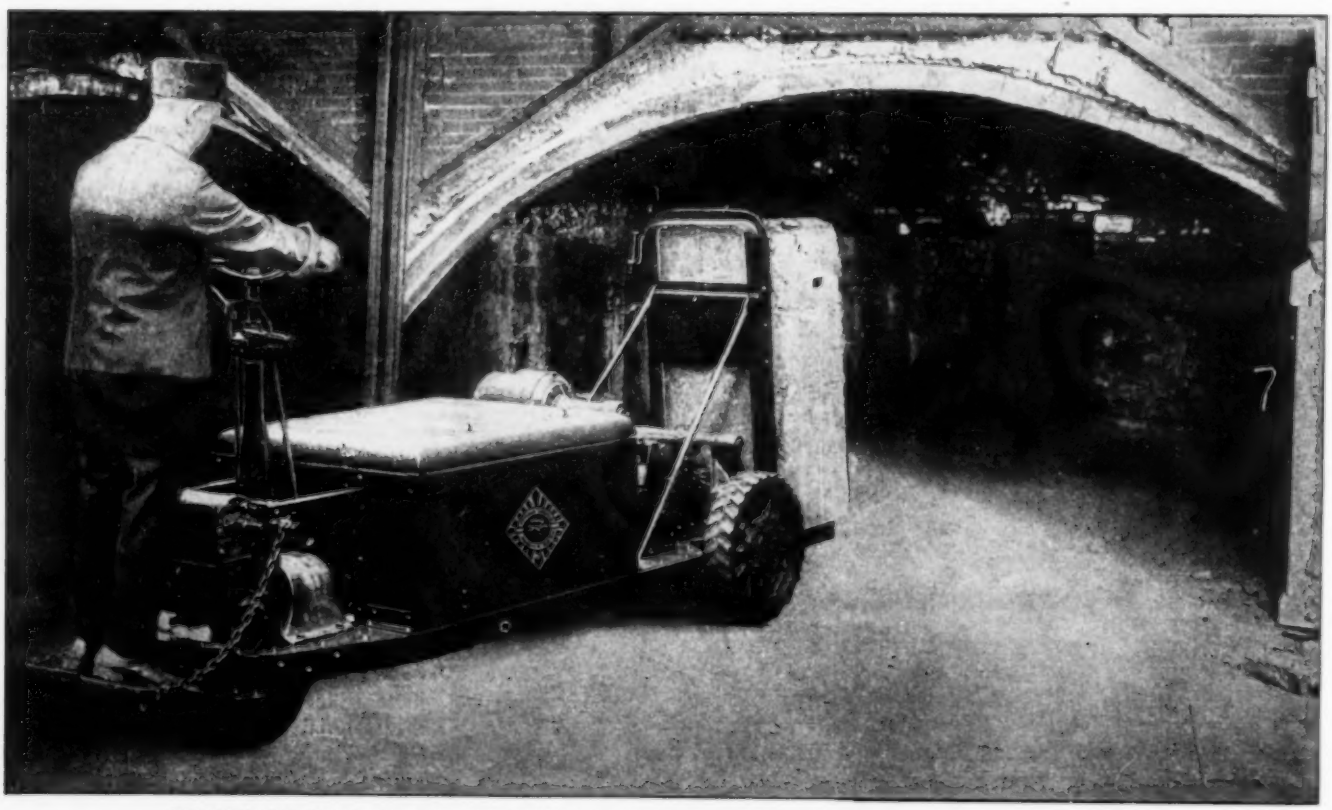
The single wheel beneath the operator's platform is steered by an automobile type control mounted on top of a vertical steering mast turning on ball bearings. The steered wheel is carried in a spring cradle which cushions the shock when the wheel passes over an obstruction on the floor. The two drive wheels do not steer and as a result the truck can be turned on a radius equal to its wheel base. All the wheels may be equipped with rubber tires when the ovens are charged at low temperature; or with smooth steel steering wheel and a pair of herringbone steel driving wheels when the oven temperature is high.

The lift mechanism consists of a series wound 4-pole motor which receives its power from the same battery as the propelling motor. This motor is equipped with a special brake and is directly connected to a worm gear which drives a worm wheel mounted on a clutch spider. The center of the clutch which is set for a 25 per cent overload is a nut through which a multi-thread worm or ram works. This ram is attached to a toggle lift mechanism which raises or lowers the forks depending on the direction of motor rotation. The lowering or raising of the forks may be stopped at any point by manually opening a switch, a feature which prevents the pots from upsetting if improperly picked up or placed. The lift mechanism is a complete enclosed unit and as such may be removed for inspection. All working parts run in oil at slow speed. The driving unit also consists of a totally enclosed motor direct connected to a worm gear which drives through a 4-bevel pinion differential to wheels. The axle is the full floating type. No weight is carried on the drive shafts. The wheels carry 7½ inch double row ball bearings and a contracting type brake is placed between motor and differential.

Control Is Fool-Proof

When in service the operator stands on two pedals, one of which controls the brake. When this pedal is pushed down by the operator's left foot the brake is off. When right pedal is depressed the circuit breaker closes (only if the controller is in off position) connecting controller with battery carried on the mid-frame. The operator must stand on the truck to drive it and it stops automatically when he steps off.

To operate the pot lifting device, a switch first is closed and then the forks move close to the floor as set after which the truck is driven forward and the forks inserted beneath the pot stool. A trip stops the lifting mechanism at a predetermined height as may be desired.



THE OPERATOR MUST STAND ON THE TRUCK TO DRIVE IT AND IT STOPS AUTOMATICALLY WHEN HE STEPS OFF

Equipment Inquiry Continues Light

Slowness in Foundry Operations Has Reacted to the Disadvantage of Equipment and Supply Manufacturers — Hopeful Feeling Prevails

WHILE a greater feeling of optimism is noted in the foundry equipment and supply industries, there is no marked improvement in sales. Inquiries are few in number and mostly may be characterized as feelers, although a betterment in foundry operation no doubt would see an early return of normal buying. The resumption of part time operations in some automobile plants, and a slight improvement in malleable foundry operations constitute practically the only tangible evidences of betterment. A number of large eastern foundries which have been closed, again have resumed operation, and some new construction is in prospect.

Small Improvement in the East

DULLNESS continues to characterize the foundry equipment market, through the eastern central states. A small amount of business comes to sellers of this class of machinery as always is the case, but no tendency to replace equipment in foundries during the present more or less idle period is noted. The American Chain Co., York, Pa., is a possible purchaser of additional foundry and pattern shop machinery for its new plant which is nearing completion. The Windsor Foundry Corp., Windsor, Vt., is in the market for a nine to 10-ton per hour cupola as well as two 36 x 48 tumbling barrels. The Early Foundry Co., 81 Sarah street, South Side, Pittsburgh, had a fire in its 4-story brick building recently but so far as can be learned damage done to the foundry machinery will not cause replacements. The Holmes Foundry Co. has installed an electric furnace purchased from the Electric Furnace Construction Co., Philadelphia.

Pittsburgh District Quiet

WHILE the eastern foundry equipment market is sharing in the general improvement in sentiment noted at this time, little in the way of actual business contributes to this betterment. Both inquiries and orders continue of small volume, and the market for the present remains at a standstill. However, several new projects are getting under way in the East, and this development, when contrasted with the relative lack of buying during the past weeks is condusive to the belief that substantial buying is not far off. Resumption of operations at many of the plants, which for some time past have been closed or partly closed, is also a factor for greater optimism. Further, there have been few if any failures in the foundry industry which is taken as significant of a good financial position. Prices generally are holding steady, although one large manufacturer has reduced his quotations on flasks approximately 20 per cent. Better manufacturing facilities are said to have made this reduction possible, and not any material reduction in the cost of supplies or labor. Included in newer projects reported in the East is a foundry for Robert Embers, 209 King street, Brooklyn, to cost about $40,000. Another is a $30,000 foundry for the Morton McI. Dukehart & Co., Baltimore. The West Bridgewater Foundry Co., West Bridgewater, Mass., recently mentioned, is now in the market for equipment.

Inquiries Light in Chicago

WITH most foundries operating at a small percentage of capacity and many only part time, demand for equipment and supplies naturally is at a low mark. One concern catering to foundries finds most of its correspondence requests for longer time to make payments on accounts and inquiries as to when prices will be lower. For the most part there has been little change in prices and such cuts as have been made are small and not general. Another dealer finds the most apparent indication of present apathy in the fact that demand for ladles has fallen off sharply. Usually this is among the most active items in its catalogue as this sort of equipment is burned out rapidly under continued use. A manufacturer of sand mixers finds inquiry has been stimulated since the first of the year, but sees in this a sign of economy through the use of old sand re-tempered by treatment in the mixer. These inquiries seem to be real and sales probably will follow. While there is little new construction, the Keith Furnace Co., Des Moines, Iowa, is having the Charles C. Kawin Co., engineers, Chicago, prepare plans for a gray iron foundry of 10-tons daily capacity. Other portions of the plant will be built, but the foundry probably will not be undertaken until late in the present year. The Hayton Pump & Blower Co., Appleton, Wis., operating in the former Killen-Strait tractor works, is enlarging its foundry and increasing the equipment of its machine shop.

What the Foundries Are Doing

Activities of the Iron Steel and Brass Shops

The Converse Foundries Co., Alliance, O., recently was incorporated with a capital stock of $100,000.

The Henry Furnace & Foundry Co., Chagrin Falls, O., has purchased a site of 17 acres.

Capitalized at $125,000, the Yale Piston Ring Co., Boonton, N. J., recently was incorporated by Fred S. Yale, T. G. Saxton and I. G. Yale.

The capital stock of the Simms Foundry Co., Racine, Wis., recently was increased from $40,000 to $100,000.

Bids were recently called for by the Beach Foundry Co., Ottawa, Ont., for the erection of a foundry building.

Capitalized at $250,000, the Newark Foundry Co., Newark, N. J., recently was incorporated by Eugene Edwards, M. C. Wright and Oliver T. Taylor.

The capital stock of the Sivyer Steel Casting Co., Milwaukee, recently was increased from $400,000 to $800,000.

Erection of a plant building, 50 x 125 feet, is reported under consideration by the March Valve Co., Erie, Pa.

The Rigby Valve & Machine Co., Sharon, Pa., recently was incorporated with a capital stock of

$50,000, by W. P. Shaw, West Middlesex, Pa., Patrick Wilson, E. B. Stewart and J. C. Persch.

A foundry building in course of construction by Goldhammer Bros., Claypool, Ind., recently was partially wrecked by a windstorm.

Contract has been awarded by the Calumet Foundry Co., 7033 South Chicago avenue, Chicago, for the erection of a plant building, 46 x 50 feet.

The Lumen Bearing Co., 1155 Sycamore avenue, Buffalo, has increased its authorized capital stock from $200,000 to $500,000.

Capitalized at $41,250, the Frontier Brass Foundry, Inc., Niagara Falls, N. Y., recently was reorganized.

The plant of the C. Heinz Stove Co., 100 North Second street, St. Louis, recently was damaged by fire.

The Great Lakes Malleable Iron Co., 715 Clinton street, Milwaukee, recently increased its capital stock from $150,000 to $250,000.

Work has been started on alterations to the Pyott Foundry Co., 328 North Sangamon street, Chicago.

The capital stock of the Bessemer Gas Engine Co., Bessemer, Pa., recently was increased from $800,000 to $1,000,000.

The capital stock of the Co-Operative Foundry Co., Gates, N. Y., recently was increased from $200,000 to $500,000.

The capital stock of the Chicago Malleable Castings Co., Chicago, recently was increased from $100,000 to $1,500,000.

The Weir & Craig foundry, Wallace street and Twenty-fourth place, Chicago, has been sold to William B. McIlvaine.

The Miles Piston Ring Co., 900 West Jackson boulevard, Chicago, has awarded a contract for the erection of a building, 98 x 161 feet.

The capital stock of the Generator Valve Co., 47 Dinsmore place, Brooklyn, N. Y., has been increased to $40,000.

The Jackson & Crow Machine Co., Morgantown, W. Va., is reported planning to rebuild the section of its foundry which was recently damaged by fire.

Morton McI. Dukehart & Co., 641 Light street, Baltimore, plans the erection of a machine shop and foundry building, 40 x 125 feet.

The Morris Metal Products Co., Bridgeport, Conn., has awarded contracts for the erection of additions and the making of alterations to its foundry.

Capitalized at $10,000, the Reliance Foundry Corp., Rochester, N. Y., recently was incorporated by F. J. Tartant, W. S. Hall and A. C. McCord.

The O. K. Stove & Range Co., 1511 South Brook street, Louisville, Ky., has awarded a contract for the erection of an addition to its plant, 60 x 200 feet.

The Valley Falls Foundry & Machine Co., Valley Falls, R. I., has taken over the former plant of the Rhode Island Perkins Horse Shoe Co., and will begin operations shortly.

The J. I. Case Plow Works, Racine, Wis., is erecting a malleable iron plant, which is expected to be ready for operation about March 15. The first unit will house a 15-ton furnace.

The Quebec Brass Foundry, Des Prairies and Valet streets, Quebec, Que., has awarded a contract for the erection of a foundry building to be devoted to brass casting.

Work is reported having been started on plans for expansion of the Michigan Brass & Iron Works, Lansing, Mich. It is said the foundry buildings will be improved and enlarged.

Capitalized at $5000, the Alpha Foundry & Engineering Co., New York, recently was incorporated by M. Gusching, A. O. Briggs and M. L. Golieb, 220 Broadway, New York.

The Bay City Foundry & Machine Co., Bay City, Mich., recently received a contract from the Northern Pacific railroad for the construction of machinery for a coaling station at Hinckley, Minn.

Capitalized at $50,000, the City Brass Works, 1742 Carroll avenue, Chicago, recently was incorporated by Arthur Tausch, Albert Grosskopf and Peter Cederstrom.

The Monarch Foundry Co., Lima, O., has placed in operation a new foundry for the manufacture of light gray iron castings. F. Z. Demster, formerly of the Lima Steel Castings Co., is president, F. A. Smith, vice president and J. H. Davison, secretary and treasurer.

The Pacific Ball Bearing Co., 415 West Pico street, Los Angeles, recently was organized by Samuel Strom, 836 South Norton avenue, Los Angeles, and others.

The Stewart Furnace Co., Mentor, O., recently was incorporated with a capital stock of $1,500,000, by H. Andrews, J. S. Brumback, G. B. Houseman, T. J. Mills and S. B. Pearce.

Charles Froelich, Inc., Troy, N. Y., has been incorporated with a capital stock of $10,000, to engage in the manufacture of stoves, furnaces, etc., by F. C. Filley, A. V. and C. Froelich.

Contract has been let by the Ideal Foundry Co., Grand Rapids, Mich., for the erection of an addition to its plant, which will permit the installation of 12 additional brass furnaces.

The Marion Mfg. Foundry & Supply Co., Marion, Ind., is holding in abeyance erection of its proposed plant building, 45 x 100 feet, until some time in April.

The Republic Furnace & Radiator Co., Maryland Casualty Tower, Baltimore, recently was incorporated with a capital stock of $2,000,000, by E. McClure Rouzer, E. S. Stockbridge and others.

The Kinney Sulky Plow Corp., Elmira Heights, N. Y., recently was incorporated with a capital stock of $25,000, by M. Ostrander, E. Buhr and C. Kinney, to manufacture plows and other agricultural implements.

The Flood City Mfg. Co., Messenger and Elder streets, Johnstown, Pa., manufacturer of brass and bronze products, is reported planning the erection of a plant addition, 80 x 200 feet. J. L. Hershberger is president of the company.

The Mask Furnace Co., Ltd., Chatham, Ont., recently was incorporated with a capital stock of $250,000, by E. M. Reeve, B. L. Bedford, Charles J. Cummings and others, to engage in the manufacture of furnaces, stoves, heaters, etc.

The Penn Foundry & Machine Co., Bath, Pa., has been incorporated with a capital stock of $500,000, by E. N. Gackenbauch and Charles I. Berlin, Bath, Pa., and H. R. Stout, Nazareth, Pa., to engage in the manufacture of iron and steel castings, machinery and parts.

The capital stock of the Northwest Engineering Co., Green Bay, Wis., recently was increased from $1,000,000 to $1,300,000. The company operates a ship construction yard and repair dock, and conducts a foundry and machine shop manufacturing marine engines and equipment.

The T. R. Roberts Filter Mfg. Co., Philadelphia, has disposed of its plant at Ruan and Tackawanna streets, Frankford, Pa., to Rasch & Co., manufacturer of planing mill products. The plant consists of a 2-story factory building, foundry and power house. It will be occupied by the new owner.

Capitalized at $40,000, the E. S. Bryant Pattern Works, Ltd., Windsor, Ont., recently was incorporated to manufacture patterns and engage in a general foundry and machine shop business, by E. S. Bryant, Edward J. Mamer, Detroit; Frederick G. Loeffler, Windsor, Ont., and others.

Fire recently damaged the plant of the Electro Foundries, Ltd., Orillia, Ont., according to advices from H. R. Tullhope, secretary-treasurer. He advised that one furnace was put out of commission entirely and another was slightly damaged. The furnace which was but slightly damaged has been repaired and is now in operation.

Following the purchase of the plant and equipment of the Murray-Mylrea Co., Antigo, Wis., the Antigo Tractor Co. recently authorized an increase in its capital stock from $500,000 to $1,000,000. The foundry and machine shop are being improved to provide maximum capacity and it is planned to start the manufacture of tractors on an extensive scale shortly.

The Mt. Vernon Furnace & Mfg. Co., Mt. Vernon, Ill., has advised it is erecting a plant building 100 x 250 feet. All equipment for the structure has been purchased with the exception of machinery for the sheet metal department. The company was recently organized to manufacture warm air furnaces. Officers are: President, C. L. Mullen; vice president, C. T. Mulroy; secretary-treasurer, A. St. C. Ward, and general manager, Carl Schweinfurth.

According to a report current at Birmingham, Ala., H. Leon Brittain, of New York, formerly of Birmingham, iron and steel man and shipbuilder, with his associates will establish a steel castings and motor parts plant near Rome, Ga. Mr. Brittain and associates some months ago incorporated the International Steel & Motors Corp., with a capital stock of $10,000,000.

The Kittanning Foundry Co., 1002 Empire building, Pittsburgh, which was recently incorporated with a capital stock of $25,000, has started operations in a plant at Kittanning, Pa. F. R. Edmunds, president of the company, formerly was assistant superintendent of the Dayton Malleable Iron Co., Dayton, O. James W. King is secretary and treasurer of the company.

A 1-ton Greaves-Etchells electric steel melting furnace, to be used for job casting work, etc., recently was installed at the plant of the Electric Steel Products Co., Turners Falls, Mass. The company has a preferred capital stock of $100,000, while its common stock is $200,000. Officers of the company are: President, Olaf Hoff; vice president and treasurer, Olaf Hoff Jr., and secretary, J. D. Lyman.

Work has been completed on the erection of a pattern shop for the Reading Pattern Works, Reading, Pa. The building, which is of wood, brick and concrete construction, with steel beams, is two stories, 60 x 116 feet. The first floor is to be used as an office, rest room, locker room and provide storage facilities. The second floor will be used for the manufacture of patterns. Wood and metal patterns will be made.

Advices have been received from the Frick Co., Inc., Waynesboro, Pa., to the effect that it recently increased its capital stock from $2,000,000 to $5,000,000, with a view to financing plant extensions, etc. These extensions will be undertaken as soon as the company considers building conditions favorable. The first project to be started will be a new iron foundry, as the company advises its present foundry and its equipment are inadequate for its needs. D. Norris Benedict is treasurer of the company.

In order to care for its increased business and to finance the purchase of machinery and equipment, the Fow Specialty Co., Inc., Newton, Pa., manufacturer of automobile accessories, etc., has advised it recently increased its capital stock. The company as yet has not decided on just what equipment it will purchase, but according to R. S. C. Fow, president, foundry equipment will be bought for a 5-ton foundry, punch presses, shears, metal bending machines, grinding and polishing machines.

New Trade Publications

CRANES—The John F. Byers Machine Co., Ravenna, O., is circulating a 4-page folder in which it describes and illustrates cranes which can be used for a wide range of work. These cranes can be operated by steam, gas or electricity and are adaptable for use with a clamshell or orange-peel bucket, or drag line to the hook attachment. The illustrations show the crane being used on various kinds of work.

OXYACETYLENE CUTTING—The Air Reduction Sales Co. New York, has issued an attractively illustrated booklet, "Cutting Cast Iron with the Oxyacetylene Torch," which is a reprint of a paper prepared by A. S. Kinsey, of Stevens Institute of Technology. The paper covers the subject of cutting and tells how the cut is made, gives necessary pressures of oxygen and acetylene for varying thicknesses of metal, etc.

INDUSTRIAL BUILDINGS—An illustrated booklet of 24 pages is being circulated by the Sam W. Emerson Co., Cleveland, in which a number of representative plant buildings erected by the company are illustrated. The illustrations given include those of foundries, machine shops, heavy metalworking plants, automobile building plants, and business structures.